THE MARINE REVIEW

VOL. 43 CLEVELAND JUNE, 1913 NEW YORK No. 6

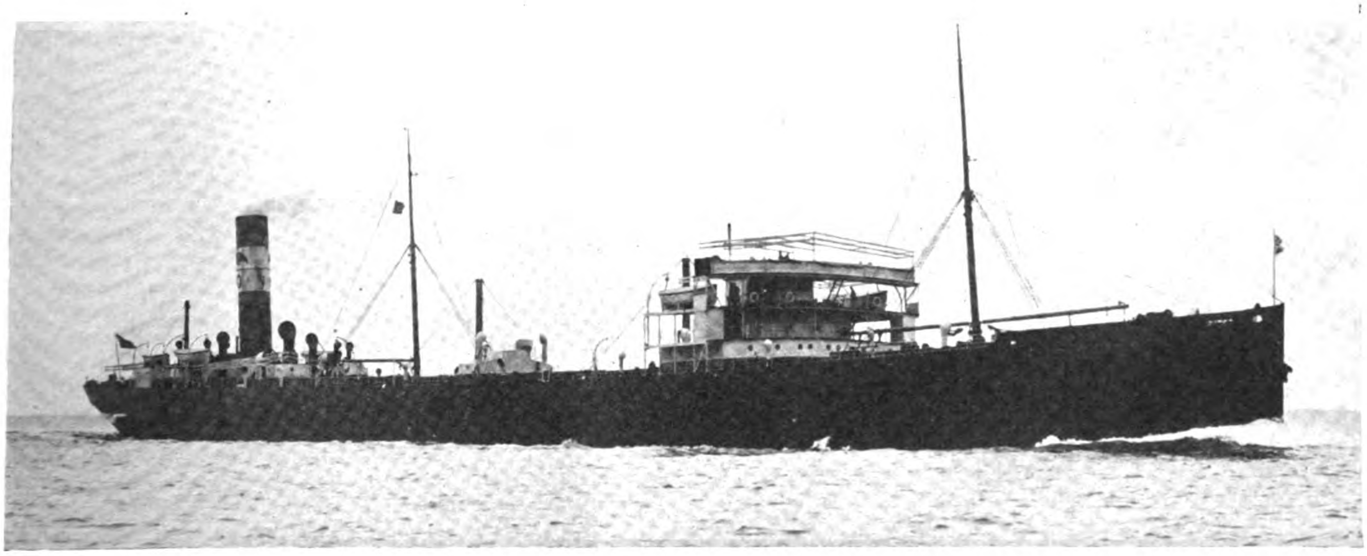
Oil Tanker San Fraterno

Among the Most Interesting Class of Tonnages Building at Present in Great Britain Are the Oil Tankers

By F. C. Coleman

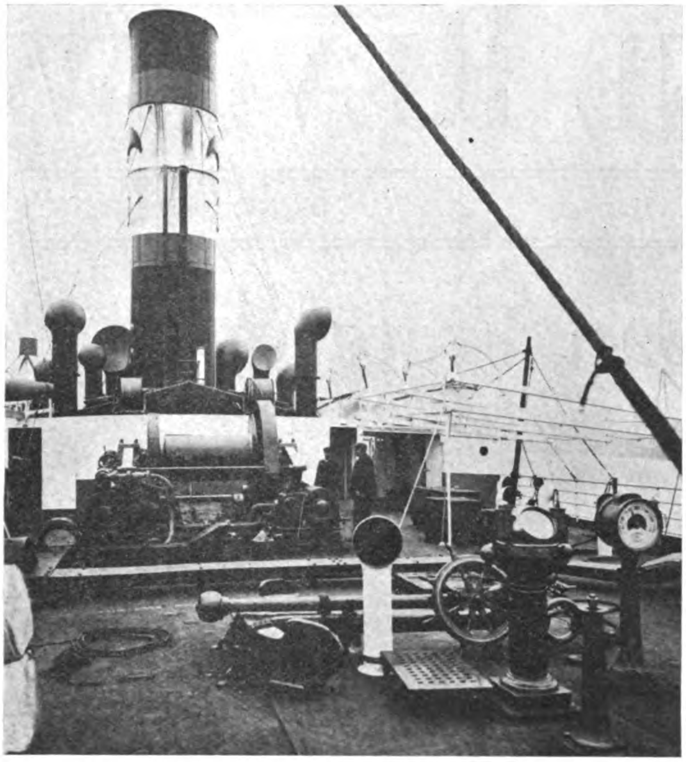
APART from the large mail and passenger steamers, probably the most interesting class of mercantile tonnage now under construction in Great Britain are the ten 15,700-ton oil-carrying steamers for the Eagle Oil Transport Co., Ltd., an important syndicate presided over by Lord Cowdray, which is actively engaged in the exploitation of a territory of over 75,000 sq. miles of oil-producing land in Mexico. Orders for these ten oil-carriers were placed last year with Sir W. G. Armstrong, Whitworth & Co., Ltd., of Walker-on-Tyne, and Swan, Hunter & Wigham Richardson, Ltd., of Wallsend-on-Tyne, who were to build three each, whilst Palmers Shipbuilding & Iron Co., Ltd., of Jarrow-on-Tyne and Wm Doxford & Sons, Ltd., of Sunderland, were entrusted with the construction of two vessels each. All ten vessels are to be built on the Isherwood system, as the owners desired to take advantage of the decrease in weight allowed by the longitudinal system of framing, and they also recognized the advantages gained by clearer holds, besides the increased dead weight. They are to be generally similar, differing only in points of small detail, for in some instances the main deck will be parallel to the keel line for the length of the oil tanks, instead of having sheer as will the others. The first of these vessels to be passed into service is the San Fraterno, which was built by Swan, Hunter & Wigham Richardson, Ltd., and illustrations of which are given on this and other pages of this issue.

The San Fraterno is 541 ft. 6 in. over all length, 66 ft. 6 in. extreme breadth, and carries 15,700 tons of oil on a 27 ft. 11 in. draught. Her contract speed is 11¼ knots, which was exceeded during the trials which took place off Tynemouth towards the end of April. The propelling machinery consists of quadruple-expansion engines, built by the Wallsend Slipway & Engineering Co., Ltd., and having cylinders 28½ in., 41 in., 58 in., and 84 in., with a stroke of 54 in., and steam is supplied by four cylindrical boilers, each 16 ft. 3 in. diameter and 12 ft. long, designed for a working pressure of 220 lb.

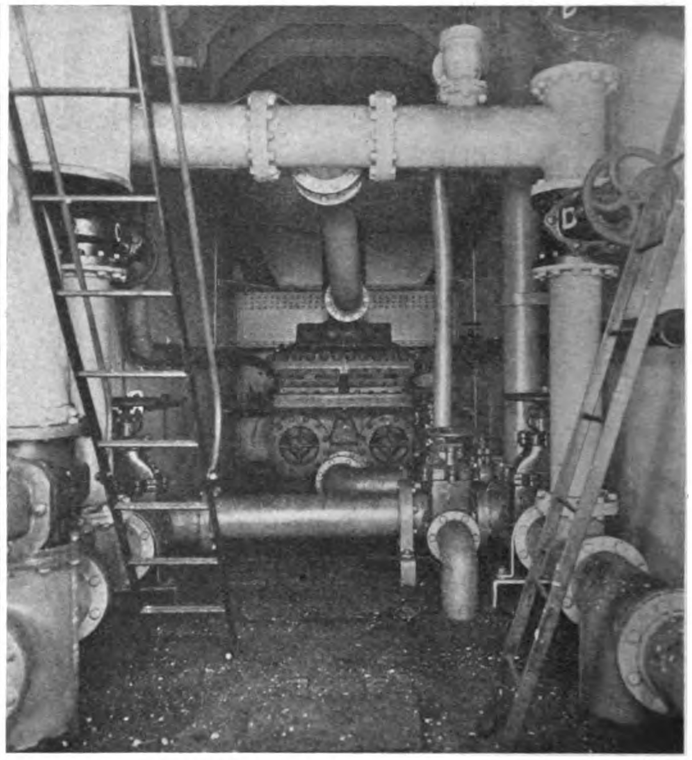


THE OIL TANKER SAN FRATERNO

The machinery is placed in the after end of the ship, and the boilers are fitted for burning oil fuel on the Wallsend-Howden patent system. The pumping plant for the liquid fuel is in a separate chamber, thus keeping the stokehold clear as far as possible of oil-fuel pipes and fittings. The oil holds and bunkers are divided in 13 compartments by transverse bulk-



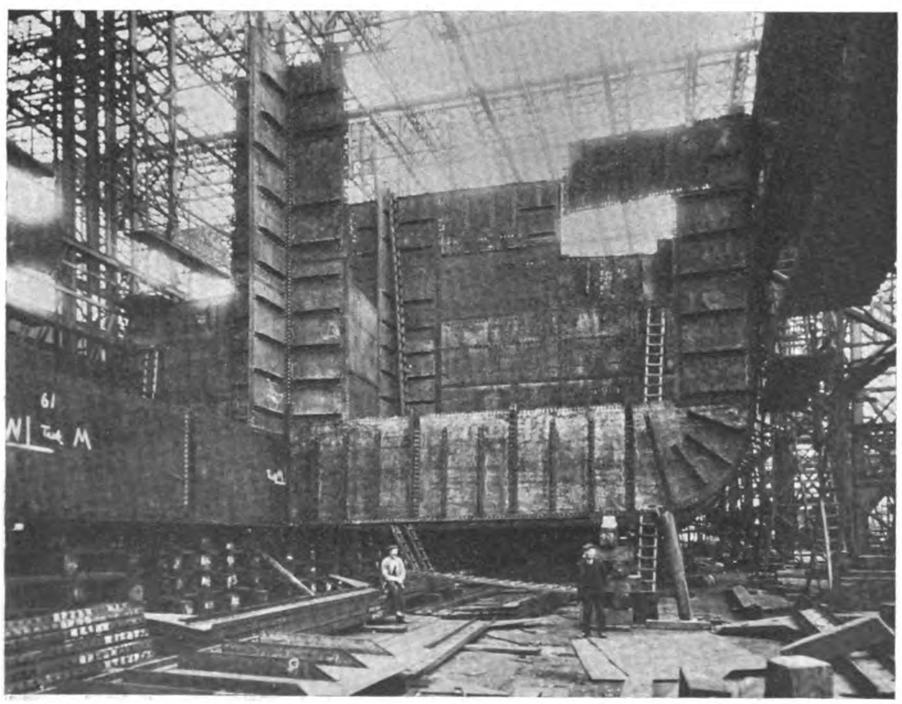
AFTER DECK, SHOWING TOWING WINCH



PUMP ROOM OF OIL TANKER SAN FRATERNO

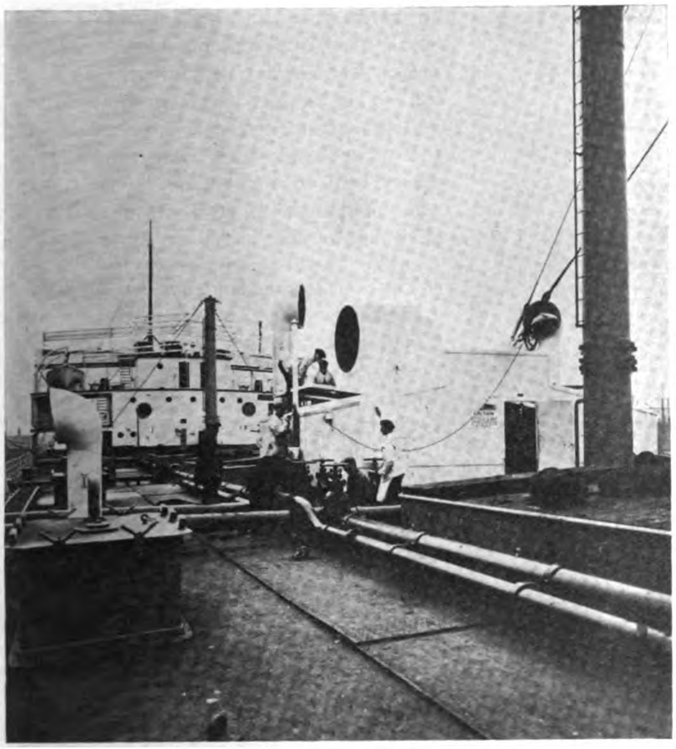
heads, and they are further sub-divided by a central longitudinal bulkhead which is carried through all the holds, pump rooms and cofferdams. There are two cofferdams 5 ft. in length at each end of the range of oil holds. The spaces at the sides of the main expansion trunk are utilized for carrying oil fuel, and they have separate small expansion trunks extending through the shelter 'tween decks.

The oil fuel supply for the boilers is carried in a large cross bunker aft, and at the sides of the main expansion trunk, an arrangement which tends to the simplification of the trimming of the vessel as the center of gravity of the ship is not then greatly affected as the fuel is consumed. The pumping arrangements are interesting and merit more than passing notice. There are two main lines of steel suction pipe 14 in. diameter, fitted one on each side of the longitudinal bulkhead. Each line has a suction 9 in. in diameter into each tank on its own side of the ship, and passing through the longitudinal bulkhead to the corresponding compartment on the other side. There are thus two suctions in each compartment, four in each tank, an arrangement which permits both sides of the vessel to be dealt with simultaneously through the same pipe line. Each suction has a 9 in. suction valve and an 8 in. air valve, which are actuated by wrought-iron rods carried up to and passing through the shelter deck, and fitted with stuffing boxes and glands. Ventilation is by means of a fan capable of discharging 22,000 cu. ft. per minute, placed in the after pump room and connected to the pipe line, air valves being provided so as to permit the supply of fresh air into or the discharge of vapor from the tanks, as the opening in the strum may be covered by the drainage oil and cannot be relied upon for this purpose.

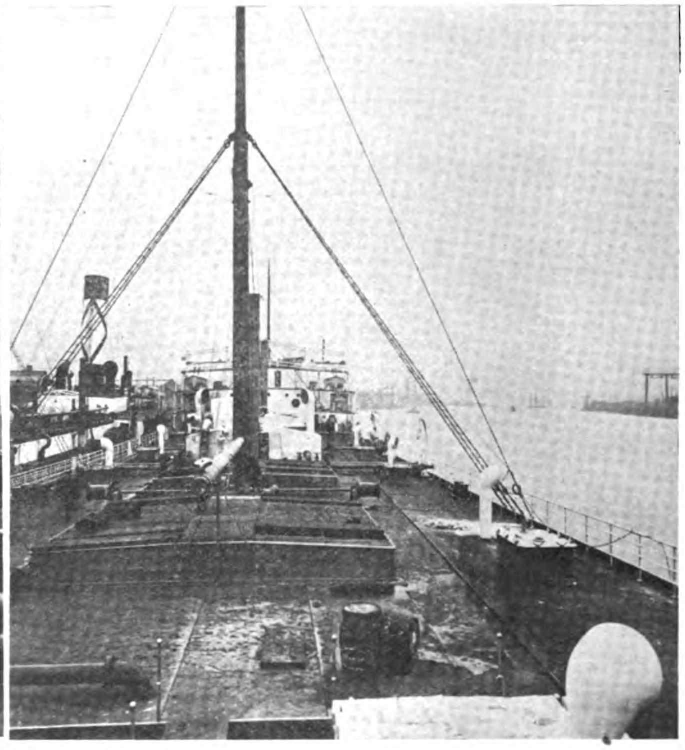


VIEW SHOWING THE ERECTION OF THE LARGE TRANSVERSES

There are two pump rooms, each containing two pumps 22 in. by 14 in. by 18 in., each pump being capable of discharging 300 tons per hour, at a pressure of 250 lb. per sq. in. There are also cross connections between the two main pipe lines situated in the endmost tanks and controlled by master valves. Oil or sea water may be pumped into or discharged from



DECK VIEW FORWARD OF BRIDGE LOOKING AFT

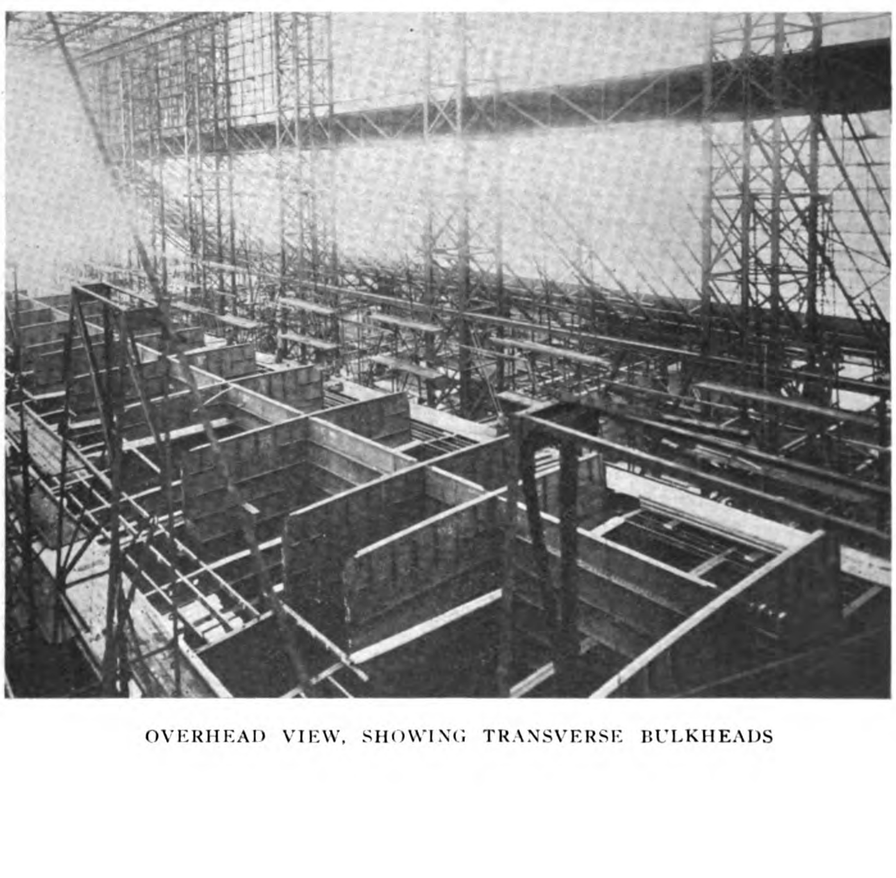


DECK VIEW LOOKING FORWARD

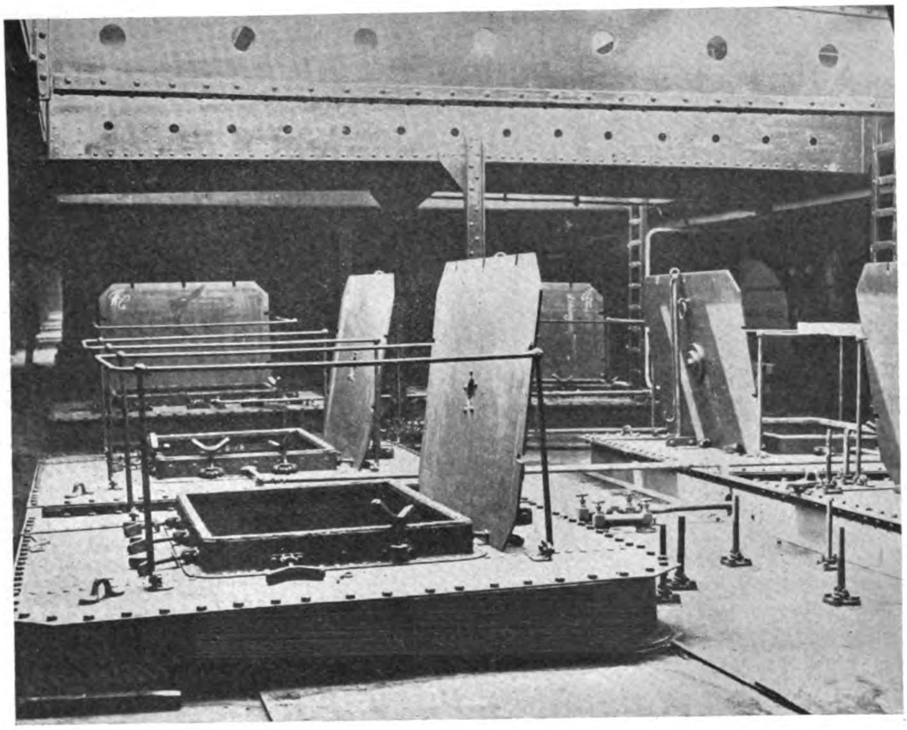
any tank, or transferred from any one tank to any other tank. There are special connections to the ship's sides to pump oil from barges by means of the ship's pumps, as to lift the oil to the shelter deck level would mean an unnecessarily large suction lift for the pumps. The oil discharge pipes are arranged so that there are two on each side at the forward pump room two at each side of the aft pump room and one over the stern. A long vertical pipe is provided in connection with the discharge main of each pump, to act as an air vessel and maintain the continuity of the discharge. Pressure gauges, indicating the steam pressure to the pumps and the pressures at the pump discharges and suctions, are situated on the after side of after pump room casing and the forward side of the forward pump room casing.

As the vessels are primarily intended to carry liquid fuel, an elaborate system of heating coils, comprising about 13,000 ft. of piping, is fitted in the oil tanks. Refined petroleum, benzine and other light oils will, of course, be carried when necessary, and the 'tween deck tanks at the sides of the main expansion trunk for the length of the tanks Nos. 5 to 8 have drain valves to the lower tanks so that they may be utilized for this purpose. The remaining 'tween decks are only connected to the oil-fuel bunker pipe lines, but they can be readily adapted for carrying other oils, if and when desired.

A separate piping installation is supplied in connection with the liquid fuel carried in a large cross-bunker aft, and the 'tween deck tanks at the sides of the main expansion trunk. By reason of the oil fuel pumps being placed in an isolated pump room any oil over 73 degrees closed flash point may be used as fuel. The captain and officers are accommodated in the bridge house amidships, the engineers' cabins are in the poop, and several extra cabins are provided in order that apprentices may be carried, whilst close to them are the crew's quarters. It will be seen from photos that a large towing winch is fitted aft for towing ocean-going oil barges. Marconi wireless telegraphy is provided, and throughout the design and equipment of the vessel—the largest oil carrier yet built—appears to be on the most approved lines.



OVERHEAD VIEW, SHOWING TRANSVERSE BULKHEADS



'TWEEN DECK, SHOWING THE OIL TIGHT HATCHES WITH COVERS OPEN

New Steamer Berkshire

The new steamer Berkshire, built for the Hudson River Navigation Co., which operates the night line to Albany, underwent her trial trip on the Hudson last month. The new steamer is 440 ft. long and 90 ft. beam over guards, having 450 staterooms. She was designed by J. W. Millard & Bro., of New York, and contract for her construction was let to the W. & A. Fletcher Co., Hoboken, N. J., which sublet the building of the hull. The joiner work, painting and decorating was contracted for by C. M. Englis, the steam heating by Stephen Ransom, and the electric lighting by Joseph Barre & Co.

The steamer has five decks, and on three of them the promenade space is uninterrupted from stem to stern. Beneath the dome which crowns the after part of the deck is the main saloon, the ceilings and galleries of which are decorated in white and gold with art panel. The social hall on the saloon deck is finished in African mahogany. The Berkshire has a single beam surface condensing engine, diameter of cylinder 84 in. and stroke of piston 12 ft. Her paddle wheels are of the feathering bucket type, 30 ft. outside of bucket, 12 curved steel buckets in each wheel, each bucket 3 ft. 9 in. wide by 12 ft. 11½ in. long. There are four main boilers of the lobster back return tubular type built for 55 lbs. working pressure. Each boiler has a shell 9 ft. 6 in. mean diameter by 33 ft. 4 in. long; width of front of boilers 11 ft. 10 in. The steamer also has a donkey boiler built for 100 lbs. steam pressure. The lighting plant is quite extensive, consisting of three 50-k. w. generating sets built by the General Electric Co., and she has a very complete system of fire wrecking and sanitary pumps.

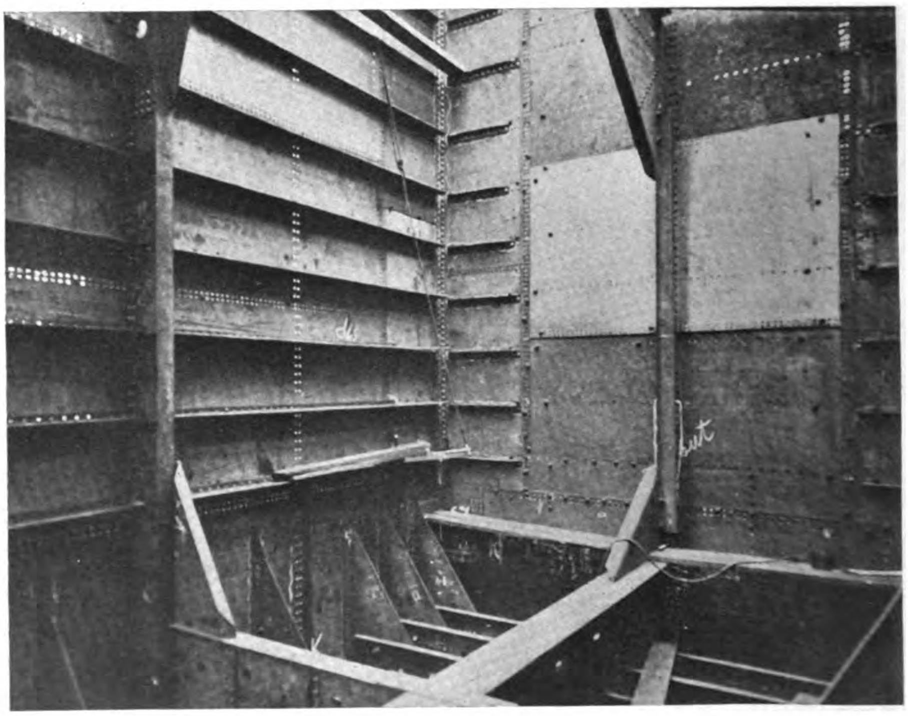
The fire service is of the four standpipe type, having a forward port and center, a forward starboard and center, an after port and center and a starboard after and center standpipe. There are 56 fire nozzles throughout this service. The steamer has two independent systems of steering gear, one steam and the other hand, each system having its direct lead to the rudder. The boilers are enclosed with steel from the main deck up to and including dome deck.

The Gas Engine & Power Co. & Charles L. Seabury & Co., Morris Heights, New York, launched the twin-screw gasoline cruising yacht Blue Bird on May 10 for C. L. Poole, of Chicago. The new craft is from the designs of Gielow & Orr, and her owner, as soon as the Panama canal is opened, intends to make a trip in her through that waterway to the Pacific coast.

Edward Wortmann, traveling passenger agent of the North German Lloyd Steamship Co., who has just completed his fortieth year in the company's service, was guest of honor at a dinner of 300 railroad and steamship men at Rector's, New York, recently.

The two steel ferry boats contracted for by the Pennsylvania railroad with the Harlan & Hollingsworth Corporation, Wilmington, Del., will be 168 ft. long, 55 ft. beam over guards and 14 ft. 8 in. deep.

The Pennsylvania Railroad Co. has awarded the Pusey & Jones Co., Wilmington, Del., a contract for two derrick barges, 100 ft. x 30 ft., for service in New York harbor.



VIEW OF PART OF OIL HOLD, SHOWING LONGITUDINAL FRAMING AND ABSENCE OF DOUBLE BOTTOM

Development of Seattle

The Plans of the Port Commission for the Extension of Steamship Terminals

ALTHOUGH it is more than a year since the voters of this city authorized the port commission to issue bonds for the development of steamship terminals on what is known as Harbor Island in Elliott Bay, this property to be leased to a private company, the matter is still unsettled. Next month a special election will be held at which the voters will be asked to determine where they wish the first unit of a great scheme of deep sea terminals located.

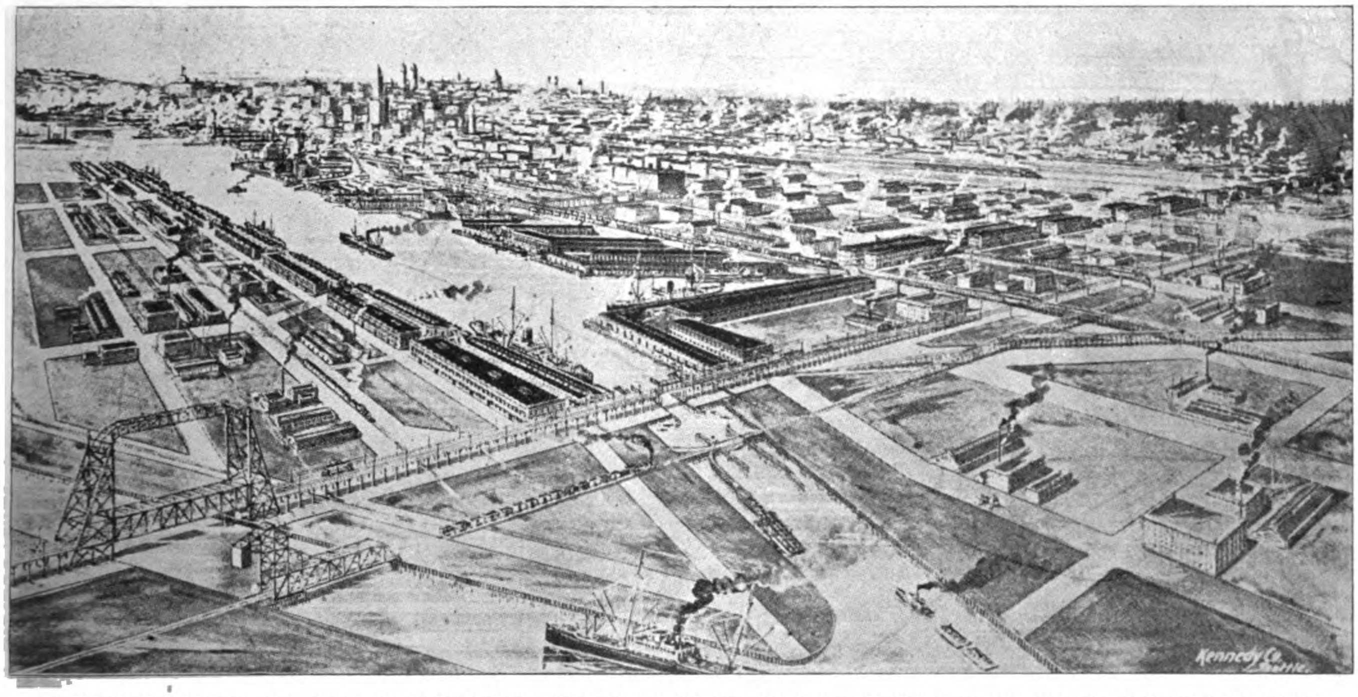
The election last year authorized the commission to sell $3,000,000 in bonds for the erection of several 1,400-ft. piers and to acquire the necessary property. This was to be leased by the Pacific Terminals Co., of New York, which in turn was to invest $2,275,000 in constructing warehouses and erecting industrial plants adjacent somewhat after the plan of the Bush terminals at Brooklyn. By vote the commission was instructed to issue $2,000,000 additional in bonds for the extension of the improvement scheme as conditions warranted.

After many months of delay the eastern capitalists have failed to begin work and it being evident that they could not fulfill their contract, the commission last month abrogated the agreement. In consequence, the work of providing adequate facilities for the additional commerce which it is believed the opening of the Panama canal will bring to Puget Sound has been delayed. One reason for the failure of the eastern company to make good is the fact that the Seattle port commission, in its desire to protect the public interests, drove an unusually sharp bargain. To the severity of the terms of this contract, the Pacific Terminals Co. attributes its failure to thus far secure the capital necessary to undertake the project.

Although today Seattle has not yet begun the construction of the first unit in its plan of greater deep water facilities, the port commission has already undertaken several smaller projects, including the erection of general steamship terminals in the East Waterway, the acquisition of lands for what will be known as the central waterfront improvement, the construction of great lumber wharves at Smith's Cove and the erection of wharves and landing stages for the fishing fleet at Salmon Bay. These projects are all within the city limits and they offer some slight idea of the size of Seattle's harbor and the multiplicity of improvements to which it will lend itself.

Fig. 1 gives a bird's eye view of the proposed improvements where Seattle expects to afford adequate accommodations for the overseas vessels which are expected to call here. In the foreground is seen what is known as the East Waterway, extending northward from the bridge. This waterway was created from the tidelands by dredging, the material from the channel being used to create Harbor Island, which is seen to the left. The city's present harbor facilities are largely nearer the center of Seattle, north of the East Waterway, although there is a large area of tideland, on which are located many factories, alongside the East Waterway.

As originally planned, the great piers were to have been erected at the north end of Harbor Island, but owing to the fact that this scheme has practically been abandoned by the private capital which it was expected would invest, the port commission has developed a plan for building the first unit at the head of the East Water-

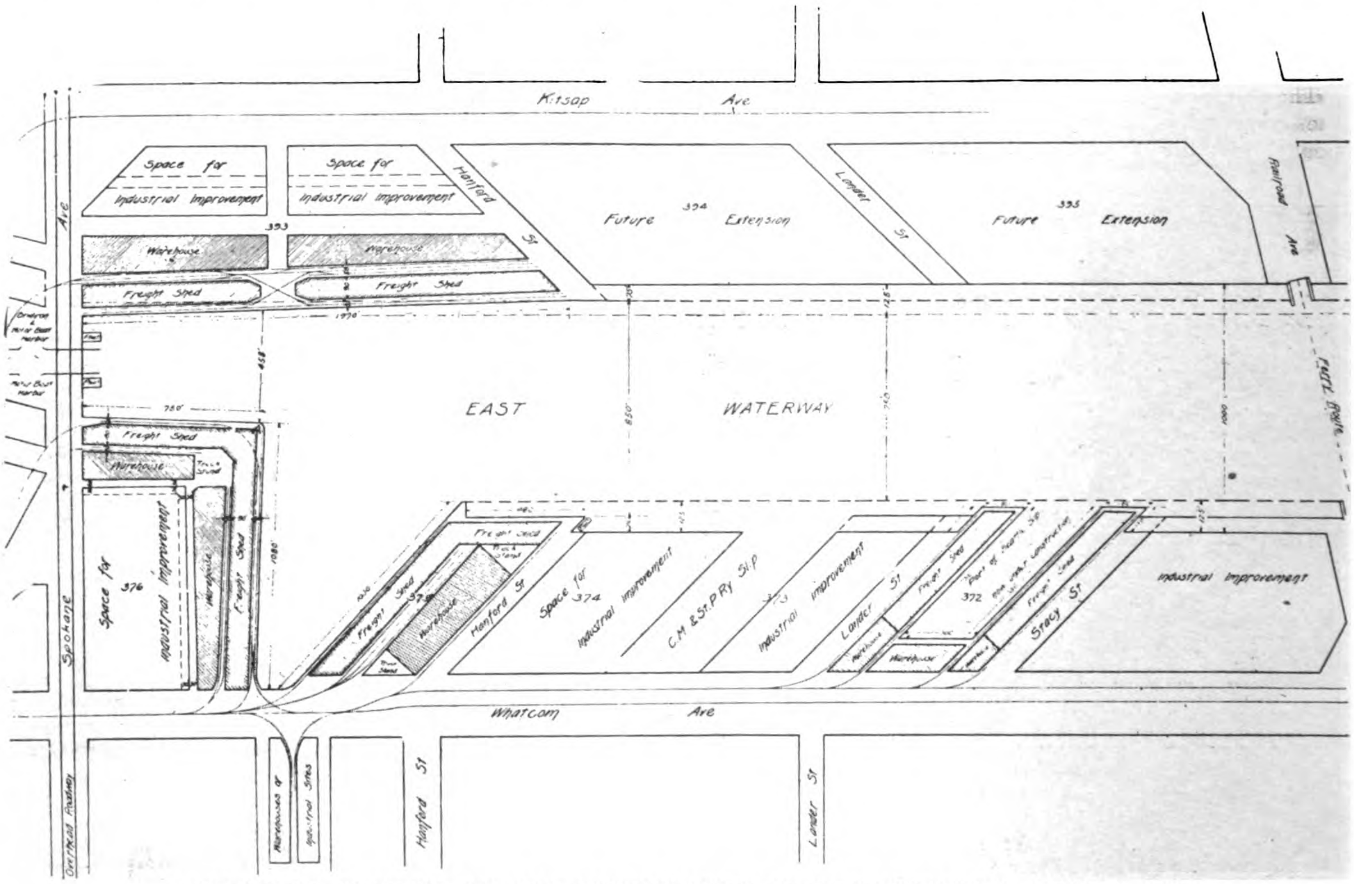


BIRDSEYE VIEW OF PORT COMMISSION'S PROPOSED PLANS FOR PROVIDING DEEP SEA TERMINALS IN EAST WATERWAY, SEATTLE

way, as it is believed that here it will be more practicable to begin a great scheme of port development. While the north end of Harbor Island is admitted to be splendidly adapted for giving wharfage accommodations to large ships, the commission believes that it will be more reasonable to build quays along the upper portion of the East Waterway, and as conditions demand, to extend these facilities along the west side of the waterway until eventually the outer portion of Harbor Island is required. One of the commission's best reasons for desiring to utilize the south end of the waterway is its greater accessibility to the business and wholesale centers of the city. channel of 30 ft. It is the intention of the commission to do considerable dredging and eventually to afford a uniform depth of 40 ft. for a width of 850 ft. This waterway is well sheltered from all storms, as in fact all portions of Seattle's harbor are, but the proximity of the East Waterway and the level haul to the level tidelands, which are capable of great industrial development, are factors in its favor, according to the commission. Consequently the port desires to have the $3,000,000, voted for Harbor Island, diverted to the first unit of the East Waterway plan, and for this purpose the special election is about to be held.

While many experts agree with the extending to the right. These, of course, are only proposed, but the site is property whose control was recently vested in the commission. Several years ago, it was acquired for the purpose of excavating a canal, but this plan was abandoned. Now the land will be utilized by the commission for the fostering of industrial enterprises, which will be splendidly situated as regards both rail and water facilities.

In planning for the first unit at the end of the East Waterway, the commission figures it will cost about $2,400,000. It is planned to provide 5,390 lin. ft. of berthing space, 140,200 sq. ft. of wharves and sheds and 470,550 sq. ft. of warehouses. The improve-



OUTLINE OF PROPOSED HARBOR IMPROVEMENTS IN EAST WATERWAY, SEATTLE, WASH.

Harbor Island can be reached only by a long and circuitous route or by ferry and the latter plan is not regarded as especially advantageous.

The East Waterway is approximately 1 mile in length and penetrating an already busy portion of the city's waterfront, it is deemed expedient to erect wharves and quays along its sides. Its width averages 1,000 ft., although it is not believed that more than 850 ft. will be utilized when the plan is perfected. Authority over this waterway was vested in the commission by the legislature, to take effect in June. On a cross section of 500 ft. there is a present depth in this port commission, other influential citizens regard it as a mistake not to immediately develop the north end of the island, as originally proposed. Consequently there is a somewhat heated controversy at present under way. Both plans have their advocates and both have advantages so that whichever is authorized by the voters, Seattle is certain to be provided with modern terminals. Either site is advantageously situated as regards railroad facilities and both have many acres of level land adjacent where industrial development may proceed apace. In Fig. 1 may be seen a row of warehouses and factories ment contemplates the provision of sheds, grain elevators, cold storage plants and in fact every facility to take care of the varied shipping interests of a great seaport. All of these features will be co-ordinated by railway, truck and other conveying methods so as to make it practically one united system.

While the plan is to initiate improvements on the east side of the waterway, as the scheme is extended it is intended to provide for the improvement of the entire west side by the construction of quay wharves and sheds, back of which on Harbor Island, will be located a line of con-

crete storage warehouses except where possibly a grain elevator, cold storage warehouse or some other special utility will be placed. In Fig. 2 the initial improvement is indicated as starting at the southerly end of the waterway with the idea that it be extended northward to the northeast corner of Harbor Island as rapidly as the needs of commerce will justify. Whatever plan is adopted the commission expects to have the first unit completed and in service by the middle of next year.

On both engravings may be seen the triangular shaped turning basin in which it is figured large vessels may turn without the aid of tugs. This basin will extend 1,600 ft. from east to west and is planned to meet every requirement of modern vessels.

The American-Hawaiian Steamship Co., which maintains its north Pacific terminals at Seattle, has bargained with the port commission for extensive berthing and warehouse facilities in the East Waterway. The Hamburg-American and Royal Mail steam packet lines, whose vessels are now calling at Seattle for the first time, are also expected to lease berthing space from the commission in the East Waterway. At present the principal wharves are in the harbor proper, which is north of the East Waterway. These docks are capable of berthing large vessels but in several instances they are of insufficient length to take care of the big liners now calling at the port.

Cunard Liner Aquitania

The Experiences of the Mauretania and Lusitania Have Been Embodied in Her Construction

THE Cunard line has incorporated into the design of the Aquitania all the experience and valuable information which it has gained in the construction and performance of the Lusitania and Mauretania. The leading particulars of the Aquitania are:

Length overall, ft.	901
Breadth extreme, ft.	97
Depth to C deck, ft.	64
Depth to boat deck, ft.	92½
Load draught, ft.	34
Load displacement, tons	49,500
Gross tonnage	47,000
Speed on service, knots	23
Shaft horsepower	60,000
Passengers:—	
First-class	876
Second-class	594
Third-class and steerage	1,740
Crew	1,000
Total number of persons on board	4,210

The vessel has a double bottom, 5 ft. 4 in. deep for the greater part of her length, but increased to 6 ft. 3 in. under the engine room. In the double bottom are five longitudinal watertight divisions, one on the center line, one on each side at the turn of the bilge, and one on each side in an intermediate position. As a consequence, the double bottom is divided into more than 40 separate compartments. An important feature of the Aquitania, as in the Lusitania and Mauretania, is that for quite one-half of the ship's length longitudinal bulkheads are provided at an average distance of about 15 ft. from the outer skin plating, thus forming what may be termed "a ship within a ship." The intervening spaces between the longitudinal bulkheads and the ship's sides are divided by bulkheads at short intervals into relatively small cellular compartments. In addition, there are sixteen transverse watertight bulkheads extending right across the vessel, the majority of which are carried to at least 19 ft. above the waterline, while in no case do they terminate less than 10 ft. above the waterline. As a further provision for safety, two decks are made watertight, all the openings cut in these decks being trunked up to the top of the sheer with watertight trunks. The bulkhead doors in the lower part of the ship are operated by hydraulic power on the Stone-Lloyd system, in which, by a movement of a lever on the bridge, the navigating officer can close all the doors simultaneously should the necessity arise for doing so.

The vessel has nine decks in all, named the boat, *A*, *B*, *C*, *D*, *E*, *F*, *G*, and *H* decks respectively, but the last-named only exists at the ends of the ship. The uppermost continuous deck for the full length of the ship is *C* deck, the decks above this level terminating about 200 ft. abaft the bow. *B* deck, however, forms the strength deck over the midship portion of the vessel. The boat and *A* decks are of lighter scantling, three expansion joints being provided to relieve the superstructure from longitudinal stresses. For a considerable length the sides between the superstructure decks are closed in by light steel plating, fitted with sliding windows in the manner which has been largely adopted in recent Atlantic vessels to protect passengers from the weather.

Owing to the provision of Frahm's anti-rolling tanks, which occupy a short portion of the longitudinal wing spaces, no bilge keels have been fitted, but provision has been made for attaching the keels should the anti-rolling tanks not have the expected effect.

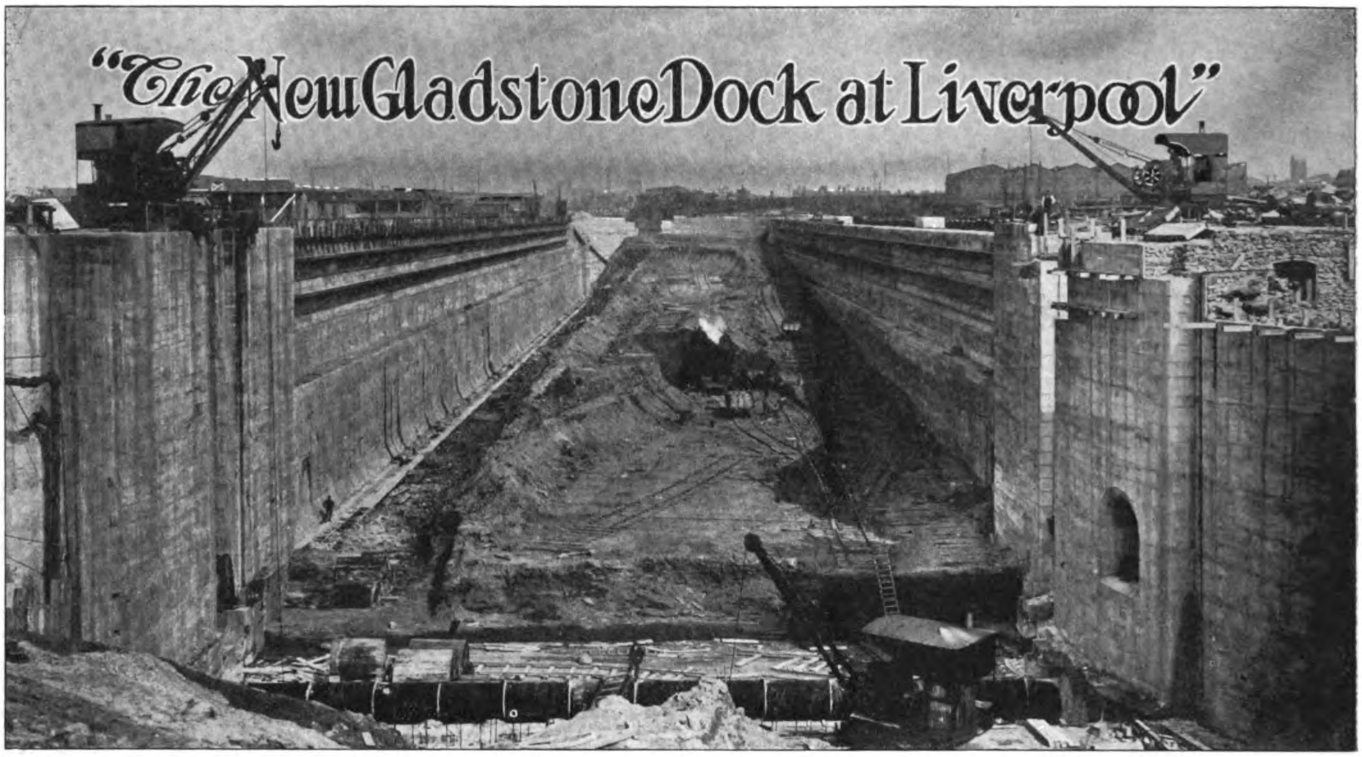
The passenger accommodation is most extensive and embodies many novel features. A description will, however, be more opportune when the vessel is completed. Lifeboat accommodation is to be provided for all on board, and will consist of two motor boats, 46 open boats and 44 decked boats, or 93 boats in all.

The order for the Aquitania was placed in December, 1910; but as the unprecedented dimensions of the ship necessitated a careful preparation of the building slip, the keel was not laid until June, 1911. A new crane system had also to be installed to facilitate the work of erection and riveting. In addition to the preparations in the yard, the river had to be deepened and widened and the builders' fitting-out basin had to be dredged in order to accommodate the liner during completion. Photographs showing the vessel at different stages in her construction are reproduced in Figs. 3 to 15, and will enable the reader to better realize the vast size of the ship. The launching arrangements were generally similar to those adopted in the case of the Lusitania, but on a scale commensurate with the increased dimensions of the latter ship. The launching weight was about 24,000 tons.

The Aquitania will be propelled by four ahead turbines, arranged in series and driving four screws. The high-pressure turbine is on one wing shaft, while the intermediate-pressure turbine is on the other, both being in separate watertight engine rooms. The two low-pressure turbines drive the inner shafts and are placed in a central engine compartment. There are astern turbines on all four shafts.

One of the low-pressure turbines is shown in Fig. 16. Steam is supplied by twenty-one double-ended cylindrical boilers, arranged in four boiler rooms. The boilers have a total heating surface of 139,000 square feet, and are designed for a working pressure of 195 lbs. per sq. in. All the boilers are fitted with Howden's system of forced draught.

It is expected that the completion of the vessel, including her trials, will occupy about a year, and that she will therefore be ready for service about April, 1914.



THE NEW GLADSTONE DOCK AT LIVERPOOL IN PROCESS OF EXCAVATION

UNDER powers obtained from parliament in 1906 for the development of land and foreshore previously acquired, the Mersey docks and harbor board promulgated a scheme for providing a large extension of its present dock system, at a cost of about £3,200,000, but owing to the depressed state of the shipping industry and the stringency of the money market, the scheme was kept in abeyance for a time. The proposals included a half-tide dock and two branch docks entered from the river by way of a large new lock entrance, also a lock connecting this extension with the existing system, all parts of the new works being designed to accommodate the largest vessels afloat, even allowing liberally for continued advance in dimensions in the future.

Owing to the rapid developments which have since taken place in the building of monster steamships, and the certain advent of at least one vessel much larger than the Mauretania and the Lusitania requiring accommodation at Liverpool within two or three years, the board were constrained to provide the convenience immediately necessary by a less ambitious scheme, capable of affording a certain amount of accommodation in a very much shorter time than would be required to carry out the whole original program. It was, therefore, decided, in the summer of 1910, to adopt a scheme submitted by Anthony G. Lyster, the board's engineer in chief, providing an entirely new dock of adequate dimensions for the purpose in view, and capable of forming ultimately an integral part of the larger scheme which could not long be delayed. This dock, called the Gladstone dock, is now being pushed rapidly on towards completion. It is expected to be ready for service in July next.

Fig. 1 shows this dock in its present isolated position, and its situation with respect to the most northerly existing dock, the Hornby dock, and to the foreshore and frontage lands north of the new dock, which, for a distance of over a mile, are the property of the board. The section AB shows the dock and its quays, sheds, etc., generally, and section CD shows the entrance channel with its guiding dolphins.

The Gladstone dock is 1,050 ft. long, or nearly 140 ft. longer than the Olympic, and has an entrance 120 ft. wide. The sill is laid at 25 ft. below Old Dock Sill datum. The structure of the dock provides for the overhauling and repairing of the largest steamers. The floor will be laid in concrete at a level of 29 ft. below Old Dock Sill, and will be furnished with center keel blocks and side blocks. The entrance of the dock will be provided with a sliding caisson of plate steel, which will have a clapping face on each side so as to maintain the water in the dock, or to exclude it therefrom, according to the nature of the duties of the dock for the time being. On the north quay, a single-story shed, 900 ft. long and 100 ft. wide, with four 2-ton movable cargo cranes, will be constructed. On the south quay, one movable crane of 5 tons will be provided, the latter being available for use on the north quay when required. The entrance channel will have a width of 400 ft. at its mouth, narrowing down to 120 ft. at the dock entrance proper. The channel and a fairway approach are being dredged to a depth of 27 ft. below Old Dock Sill. There will be a pitched slope on either side, and strong timber dolphins will be provided at suitable intervals as a guide to ships when necessary. At high water of lowest neap tides, say 10 ft. above Old Dock

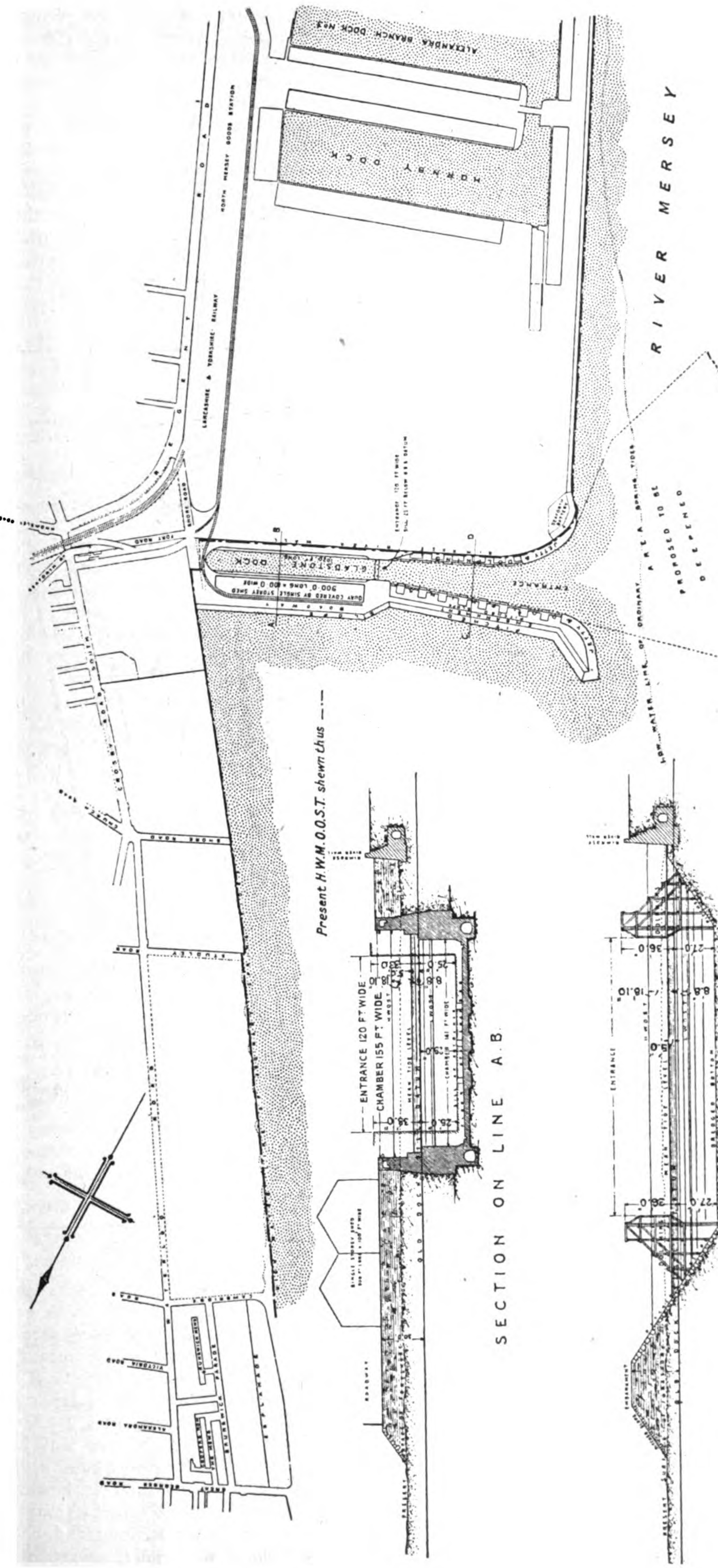


FIG. 2—SHOWING THE DOCK IN RELATION TO THE LARGER SCHEME OF DOCK EXTENSION

Sill datum, the depth of water on the sill of the dock will be 35 ft., and on high water of spring tides, say 21 ft. above Old Dock Sill, the depth on the sill of the dock will be 46 ft. In order that the dock may be rapidly cleared of water when required for use as a graving dock, powerful pumps are being installed. There are five sets of centrifugal pumps with discharge pipes 54 in. in diameter, each pump being driven by a vertical four-cylinder two-cycle Diesel oil engine, running ordinarily at 180 revolutions per minute. The contract for the whole installation is being executed by the Worthington Pump Co., but the engines will be manufactured by Carels Freres, of Ghent. The duty required of the pumps is to empty the dock of its whole contents—amounting to about 7,000,000 cu. ft. of water on an 18-ft. tide—in 2½ hours. Certain of the pumps will be specially arranged to remove the drainage water from below the general level.

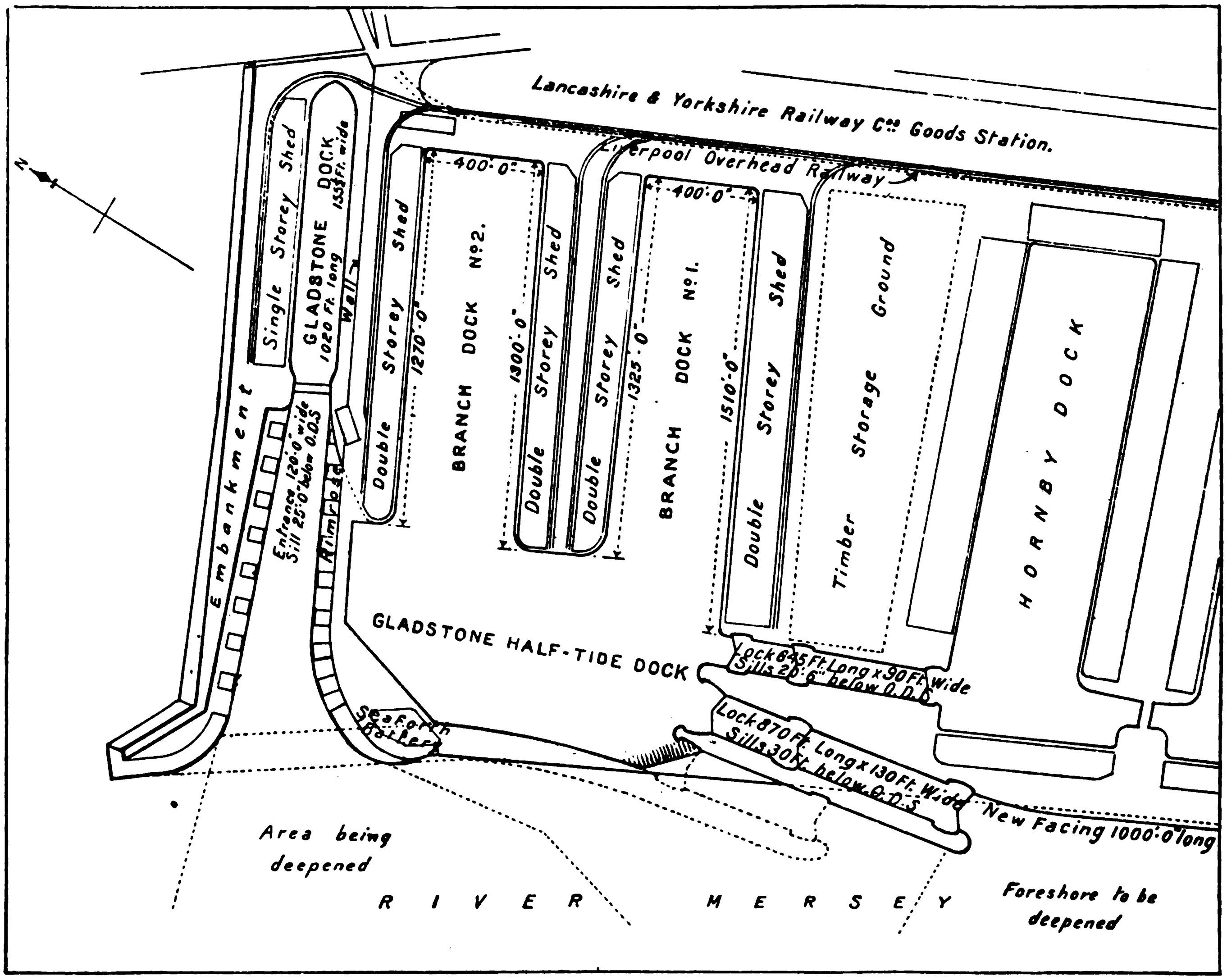


FIG. 1—SHOWING THE DOCK IN ITS PRESENT ISOLATED POSITION

Fig. 2 shows the Gladstone dock, above referred to, in more particular relation to the larger scheme of dock extension intended to occupy the space which, as will be seen from Fig. 1, lies at present undeveloped between that dock and the northernmost existing dock, the Hornby dock. In due time the independent entrance channel to the dock will be closed by the extension of the river wall, as shown by dotted lines, and the dock will then be entered from the half-tide dock described below, the new form of the south wing wall being also then altered as shown by a dotted line on the drawing.

The larger scheme above referred to, at present projected and about to be carried out, will include a vestibule or half-tide dock, with a river lock entrance 870 ft. long and 130 ft. wide, having sills at 30 ft. below Old Dock Sill. When the time comes for the laying out of the land to the northward in still further dock extensions, a second lock entrance from the river may be provided, as indicated by dotted lines, adjoining that shown in full lines on the drawing. The foreshore in front of the entrance, over a sufficiently wide area to form a suitable approach, will be lowered to suit the sill level, and the existing river wall will be underpinned and faced. To provide access from the new half-tide dock to the Hornby dock in the old system, another lock, 645 ft. long and 90 ft. wide, will be made. The sills of this lock will be 20 ft. 6 in. below Old Dock Sill. Off the half-tide dock will be provided two branch docks, No. 1 and No. 2, having long quays and good shed accommodation. No. 1 dock will have a double-story shed, about 1,295 ft. long and 100 ft. wide, on its north side; and one, about 1,465 ft. long and 150 ft. wide, on its south side; its area will be 13 acres. No. 2 dock will have a double-story shed, about 1,265 ft. long and 100 ft. wide, on its north side; and one, about 1,295 ft. long and 100 ft. wide, on its south side; its area will be 12 acres.

Floating Tunnels and Submerged Viaducts

The Merits and Possibilities as Compared to Other Systems for Crossing Navigable Channels

By Henry Grattan Tyrrell, C. E.

THE structures described in this paper include two kinds, (1) floating tubular bridges which are borne either on the surface of the water or beneath it, and (2) submerged viaducts which rest beneath the water on piers. Bridges of almost every other kind, both fixed and movable, have been built at one time or another, but none of the types considered here have yet been constructed. The condition is rather surprising, since these types have some undoubted advantages, including that of economy, over high level bridges and tunnels. Lack of precedent is, no doubt, a serious obstacle to progress in this direction, for capital is not easily interested in new and untried inventions. Another barrier in the way of introducing these types is, that whether floating or submerged, these bridges are all tubular and are subject to many of the same objections as sub-aqueous tunnels, being artificially lighted and ventilated, and often provoking that uncomfortable and uncanny feeling which accompanies travel underground. Collision with ships and the possibility of flooding have also influenced against them, and yet nearly all revolutionizing inventions have had much opposition to meet and overcome.

The structures are suitable for crossing wide or very busy channels where movable bridges of any kind would too greatly interfere with traffic on both road and water, and they may often be considered in competition with high level bridges or tunnels.

Historical Data

An invention, which is probably the first of its kind, in recent times at any rate, was patented in England in August, 1812, by J. J. Alexander McCarthy, who proposed a pontoon or floating tube with its center part deep enough below the water to allow ships to cross. This appears to have been the basis for the similar but later projects which appeared during the first half of the last century, several of which, including two by French and five by English engineers, were advanced for crossing the English Channel. Since the water in the channel is 180 feet at the center, and pier building therein would be difficult and expensive, a plan was proposed prior to 1830, by Delafons and Littlewort, for bridging it with floating piers or rows of barges, held in place by chains and anchors to maintain the piers at uniform elevation and prevent their rising or falling with wave or tide. These floating piers were to be surmounted with metal towers supporting the chains of a suspension bridge.

Tunnels of Wrought Iron Tubes

In the year 1845, M. De la Haye, of England, proposed building tunnels of wrought iron tubes in sections, which were to be sunk and afterwards connected together, and his estimate for one of this kind over the channel was $40,000,000. A plan was also proposed by a French engineer for an arched roadway on the channel bottom, the cost of which would not exceed $50,000,000. To execute the work would require forty sub-aqueous boats, 4,300,000 cubic yards of material, and the services of 1,500 men. More than 50 years ago James Chalmers prepared plans for a double track tunnel to connect the railway systems of England and the continent. He proposed using two wrought iron tubes lined with brick, floating at first from their buoyancy, and then anchored down by weight boxes filled with stone. After settling to the channel bottom, the tubes were to be covered with an embankment 150 ft. wide and 40 ft. high, the top of which would be 40 to 120 ft. below the water surface. These tubes were to be circular, and air was to be supplied through three vertical shafts at equal intervals throughout their length, the air circulation being forced with fans. Mr. Chalmers published a book describing his project, the cost of which he placed at $60,000,000. Somewhat similar schemes were afterwards advanced by Charles Marsden and Zerah Colburn.

Projects for crossing the English Channel in floating tubes were revived again, a few years later, by Martin, M. le Gay, of France, and J. F. Bateman, the last contemplating cast iron tubes, and one year later it was again agitated by J. S. Story. T. O. B. Lebret also outlined a scheme for a "channel railway ferry" on floating piers anchored to the bottom, and he published and circulated a pamphlet describing his invention. Instead of laying tubes on the bottom, W. H. Barlow explained and advanced a method of using submerged steel tubes on piers, and the scheme was further developed by P. W. Barlow, but was afterwards abandoned. The tube idea was taken up again in 1876 by the celebrated English engineer, Thomas Page, who designed many of the finest bridges in Great Britain. He favored sunken tubes as outlined by Messrs. Barlow, and intended building them in sections and then floating them out and sinking them in their proper places, as he had previously done across the harbor at Rio de Janeiro.

A method somewhat similar to this was afterwards proposed, about thirty years ago, by Maynard and Cook, for placing another tunnel under the Thames, with a 38-ft. road and two 8-ft. walks. The tube was to consist of wrought iron plates and arch ribs lined with brick and concrete casing 3½ to 8 ft. thick. Sections 60 ft. long, with closed ends, were to be built on shore and then floated into position and sunk, the method being similar in some respects to that proposed in 1845 and revived twenty or more years afterwards, for crossing the English channel.

Crossing the Sound

A scheme for crossing the sound 2½ miles wide, from Elsinore in Sweden to Helsingborg in Denmark, was advanced a few years later by Rudolf Lilljeqvist, whose plans showed provision for a single line of railway with a submerged tube resting on piers 100 feet apart on centers. It was to consist of inner and outer tubes, the smaller one having a diameter 3 ft. less than the outer one, and the space between them was to be filled with concrete. The piers were to consist of iron caissons filled with concrete and the estimated cost of the whole undertaking was $3,000,000 to $4,000,000. A similar

project from Malmo in Sweden to Copenhagen in Denmark had been proposed a few years before.

Mr. Maxton's project for crossing the Irish Channel, where the water is 600 to 900 ft. deep, appeared a little later, the estimated cost being $26,250,000. He proposed building the tubes in 400-ft. lengths and anchoring them with their tops 40 ft. below the water surface. A tunnel, if possible at all, would cost $40,000,000 to $50,000,000, and a high level bridge on floating piers not less than $150,000,000. The subject of submarine tubes was taken up also by Sir E. J. Reed, who advocated steel instead of cast iron.

Submarine Anchored Tubes

During the following year submarine anchored tubes were discussed in the scientific journals of America by Mr. J. T. Ford, with the Straits of Dover again in mind, the claim being incorrectly made that the idea was new. He advocated anchoring the tubes to cast iron screw piles 3 ft. in diameter and 50 ft. apart, screwed 20 ft. into the channel bottom.

Two other projects for submerged viaducts, somewhat similar to that proposed for crossing the straits from Sweden to Denmark, were presented by F. E. Strom, of Minneapolis, and A. M. Howarth, the latter in a competition for crossing the harbor at Sydney, Australia. In both cases, the tubes were to rest on piers, instead of floating under the restraint of anchors and cables. The Strom patent showed piers 400 ft. apart, while in the other design they were only 210 ft. apart, conforming with the contour of the harbor bottom. The estimated cost of a double track tube 3,500 ft. long between portals, under Sydney harbor, was $925,000, while a tunnel 1,680 ft. long through solid rock would cost $1,050,000 with end spirals, and $950,000 with end elevators. The cost of a high level bridge, 4,950 ft. long, including the approaches, was placed at $3,600,000. The actual water width is 1,490 ft. and its depth 50 to 60 ft., though bed rock, which is covered with 20 to 40 ft. of silt and mud, is 75 to 100 ft. below high water. The tide has a maximum rise and fall of 4 to 5 ft.

This review covers briefly what has been done up to the present to promote and build tubular bridges under water.

Classification

As stated at the beginning of this article, the structures considered here include:

(1) Floating tubular bridges, or those which float either on the surface or beneath the surface of the water, and

(2) Sub-aqueous viaducts, or those which rest beneath the water on submerged piers.

In case of floating tubes lying on the surface of the water, it is evident that in navigable channels openings must be left for water travel, and this can best be done by depressing one or more sections far enough below the surface that ships may pass over. For channels of great width, such as those separating England from Ireland and France, openings of 1,000 feet may be left four to five miles apart, their position being indicated by signals. In such cases the depressed sections would connect, by means of suitable grades, with the adjoining ones on the surface. And whether the tubes be depressed throughout, or only in places, enough space must be left above them for the passage of the largest ships which navigate that particular water. At the present time (1913) the heaviest ships afloat have a draft slightly less than 36 ft., and this amount of clearance should be given in maritime channels and harbors, though a depth of 40 to 42 ft. in anticipation of increased draft, is provided in the Panama canal. It is evident, then, that the roadway level would lie 50 to 60 feet below the water surface.

Advantages

Some of the advantages of floating tubes and submerged viaducts, are as follows:

(1) They have the shortest possible length, because the road grade is the minimum distance from the water surface, the length being less than for either a tunnel or a high level bridge.

(2) Approaches are likewise the shortest possible, with corresponding economy in the terminals.

(3) When depressed, the tubes are not subject to wind pressure, like bridges.

(4) They can be lighted and ventilated from the surface.

(5) They have continuous support and therefore require less framing than a bridge.

(6) They offer no obstruction whatever to navigation or road travel, and highways of commerce are always open.

(7) In comparison with a tunnel, they have a small height for pumping.

(8) In case of war, they can easily be destroyed and travel through them stopped, and the approaches are easily within the range of a warship's guns.

The chief objections to floating tubes are their deterioration through corrosion of the metal which would ultimately be destroyed, and the impossibility or difficulty of repairing them owing to their submerged position. In this condition the concrete or other lining would be the only material left for resisting external pressure.

Floating tubes and submerged viaducts are both supported in the water along their whole length, and as far as any other support is concerned, they need no piers, but these may be used for holding the tubes in line and preventing them from rotating, as well as for anchorage.

Tubes

Tubes must evidently have enough wall thickness to resist the water pressure, and to develop strength for supporting their own weight, together with their maximum moving loads. Circular or elliptical external outlines, approximating the true hydrostatic curve, are the most effective for resisting water pressure. "The hydrostatic arch is the true form of a linear arch under varying pressures which are always normal to it, the condition corresponding to that of an arch submerged below the surface. As the depth below the water increases, these normal pressures increase proportionately, and as the external pressures are always normal to the surface, the amount of pressure in the arch is constant, and equal to the product of the external pressure at the point by the radius of curvature. The equation is $T = pr$, and is known as Navier's principle. Since the essential principle of the hydrostatic arch is that fluid pressure is normal to the surface, the thrusts at all points of the arch ring are, therefore, constant, and cannot vary without the application of oblique or tangential pressures. Since T is constant, r will vary directly as p. These radii may be found for varying depths below water level and the corresponding curve plotted. It will be noted that the thrust T at the crown is equal to the total horizontal pressure on the extrados of half the arch."*

In practice, simple exterior curves will be found most convenient and quite satisfactory, and the inner section may be a similar curve or a rectangle, the former with its absence of angles, being preferred.

When considering the pressure that tubes must resist, it is evident that when submerged 35 to 40 ft. below water, they are free from the action of waves and wind, and lie in water that is motionless, unless there should be a current such as that from the north through the Irish Channel, and even then a slight current would not be serious. Tubes floating on the surface must be proportioned like ships to receive varying support, and to bridge the waves from one crest to another, with a uni-

*From Tyrrell's Concrete Bridges and Culverts, page 24.

form total displacement. As previously stated, the tubes under normal conditions are supported throughout their whole length, but submerged viaducts resting on piers should be designed to carry their own weight in case of accidental flooding. In such a condition, water and moving load would not occur together, and the only buoyancy would be that from the submerged metal, concrete and other materials, amounting to the difference between their weight in air and water.

The weight of the submerged tube should be such as to nearly equal the weight of the water displaced. If slightly less than the weight of water, there will be an upward pull on the anchors or piers when empty, and a corresponding downward thrust under moving load, and if so arranged that this upward and downward pressure are equal, the forces under normal conditions will be a minimum, and the cross section of the tube may be made nearly or quite uniform throughout. It should, however, be proportioned to support its own weight if flooded.

Flotation

By way of illustration, a tube is assumed which is 18 ft. diameter, made of ½-in. steel plates. If fully submerged it would displace 255 cu. ft. of water per lineal foot, weighing about 8 tons. But since its circumference is 56½ ft., its weight with ½-in. metal would not exceed 1 ton per lineal foot, and if other materials in the tube weighed another ton per foot, or a total of 2 tons altogether, the tube would be only one-quarter submerged. The buoyancy of a tube 24 ft. in outside diameter, including concrete walls 3 ft. thick, would be about 15 tons per lineal foot, and by varying the wall thickness, the weight can be adjusted and made slightly less than its buoyancy, that it may not sink.

Tubes may have double metal cylinders, of either wrought iron, cast iron or wrought steel, placed one inside the other, with a filling of concrete between them. When of structural steel, the inner and outer tubes may be ⅜ and ½ inch thick respectively, those actually built under the river at Detroit being each ⅜ in. thick. If cast iron is used it would be much thicker, perhaps 1 to 2 in. The thickness of concrete walls should be made to suit the required buoyancy, and will probably be from 1½ to 3 ft. A fine light effect may be secured inside the tubes by lining the whole interior with enameled brick, as proposed for a tunnel at Sydney.

The metal may be protected by covering it with cement or concrete, or by surrounding it with a case of sheet copper, a precaution which is hardly necessary. Materials that are submerged in sea water soon become coated with barnacles and other growth, which in themselves are a protection, and in any case, if the outer tube should be wholly destroyed by rust, the solid wall of concrete would still remain.

Tube sections may be of any convenient length up to 500 ft., those at Detroit being 260 ft. long, though 400-ft. lengths have been proposed for other places.

Anchors

When water depth does not exceed about 100 feet, a submerged viaduct or tube on piers, is preferable to a floating tube held in place only by floats and anchors. Piers are effective anchors and they also hold the tube in line, but in water which is too deep for piers, the tubes must be anchored down with chains or ropes. For this purpose, hollow cast iron screw piles 2 to 3 feet in diameter, with 12 to 18-in. blades, may be screwed into the channel bottom, the turning shaft being held in position by anchored scows, and turned by steam tugs. The pulling resistance of a 3-ft. pile 20 ft. in the ground is quite uncertain, but has been given by one authority as 2,000 to 3,000 tons.

Rotation, Ventilation and Safety Pre-

When the width of tube is much greater than its depth, as, for example, when two or more tracks lie side by side, rotation is avoided and the structure will float in its proper or horizontal position. But the rotation of single track tubes must be prevented by proper connection to the floats and anchors.

Piers

Power and ventilation in tunnels and tubes, are closely related, and any motors producing gas, steam or smoke should be avoided. Electric traction is good, but compressed air, if properly applied, may be better. Each train should in itself be a piston, fitting tightly into the tube to keep the air in motion. The accidental inrush of water from a break could then be arranged to force the trains out to safety.

Two or more tubes side by side should, for safety, be separated by longitudinal walls, so the flooding of one would not destroy the whole. Each track should also have watertight doors at intervals of about 500 feet, to close automatically in case of flood. Structures are seldom built to resist earthquakes, cyclones or other accidental convulsions of nature which may never come, and it is doubtful in this case if provision need be made for supporting a sunken ship, if one should fall across the tube.

As previously stated, the chief purpose of piers is to serve as anchors, and to hold the tubes properly in position and in line. The load on them will usually be very small, and chiefly from their own weight, but they must nevertheless be well founded to prevent undermining. Iron cylinders filled with concrete are probably the best in most cases, for the metal casing may be carried above the water during construction, and the upper part removed before placing the tubes.

Floating piers are practicable in water of great depth, and as far as possibilities of construction are concerned, a bridge might be built across the Atlantic supported on floating piers. They have occasionally been used for revolving bridges, as for example, under two swing bridges at Dublin, and the later one at Norwich, England. Some interesting designs for floating piers were prepared in the recent competition for a new bridge over the Hooghly river at Calcutta. One of these showed piers floating on the surface and varying in elevation with the tide, while another had floats anchored to the bottom, holding the piers and bridge at a fixed elevation regardless of the water height. They were proportioned for very heavy loads, carrying half a 500-ft. fixed span at one side and a 150-ft. swing span at the other, the roadway in both cases being very wide.

Construction

Tubes must usually be built on shore with closed ends, and then towed out between scows and sunk into place. Water must be excluded from the tubes during construction, and the dams for this purpose, with air-lock doors, should be 3 to 5 feet back from the ends, leaving working space for the divers while bolting the sections together. When the tube sections are lowered on the piers, a hood or roof may be applied over the connection, and the space filled up with concrete. Ball and socket joints are convenient for circular forms, and since expansion at a depth of 30 to 40 ft. below water does not exceed 1 inch in 1,000 ft. little provision for expansion is needed.

Cost and Time for Construction

The estimated cost of a double track submerged viaduct, 3,500 ft. long between portals, under a channel 1,500 ft. wide, was $925,000, with two years time for completion, while a high level bridge, 4,900 ft. long, would have cost $3,600,000. For the same location a double track tunnel 1,680 ft. long through solid rock, would cost $1,050,000 with end spirals, and $950,000 with end lifts. A somewhat similar submerged viaduct four miles long, over a strait 2½ miles wide, for a single line

of railway, was estimated at $3,250,000 to $4,300,000, or approximately $1,000,000 per mile for single track.

SUBMERGED VIADUCTS—WEIGHT AND BUOYANCY OF TUBES WITH CONCRETE LINING FOR ONE, TWO, THREE AND FOUR TRACKS

Pounds per lineal foot of tube.

	One track.	Two tracks.	Three tracks.	Four tracks.
Tube-displacement in cu. ft.....	450	820	1,200	1,580
Wght. of metal.	5,000	9,000	13,000	17,000
Wght of conc..	20,000	36,000	53,000	70 000
Total wght.....	25,000	45,000	66,000	87,000
Buoyancy	28 000	52,000	76,000	100,000
Net buoyancy..	3,000	7,000	10,000	13,000
Moving load ..	3,000	6,000	9,000	12,000

The Clyde's Largest Dredger

The Balari, launched last month by Wm. Simons & Co., Ltd., to the order of the commissioners for the Port of Calcutta, is the largest dredger yet built on the Clyde. The hull of the vessel is constructed with a central bow well through which the suction pipe is operated. Owing to the great volume of drift sand and silt of very light specific gravity deposited in the Hooghly during the flood season special consideration had to be given towards providing appliances which would efficiently retain this light material, and prevent a large percentage of loss in the overflow from the hopper when dredging operations were in progress. The dredger has accordingly been fitted with Simons patent sand trapping arrangement.

It is common knowledge that harbor authorities using suction hopper dredgers for dredging sand bars in rivers and harbors have for many years been endeavoring to find some means to accelerate the depositing of the dredged material in the hoppers, and thereby reduce the loss in overflow which is always considerable and frequently becomes excessive after the hopper gets more than half full. The Simons patent sand trapping arrangement is most effective in its action in reducing the loss in overflow to a minimum, and has been fitted by the builders in other dredgers of their construction, with eminently successful results. To assist in keeping a large vessel of this kind at her work when exposed to the strong currents of the River Hooghly the dredger has also been fitted with Simons patent arrangement of hydraulic steering jets fitted at bow of vessel.

Dimensions of Dredger

This dredger, which is 333 ft. in length by 54 ft. 6 in. by 22 ft. 3 in., has a hopper capacity of 71,600 cu. ft., and has been specially designed for the unique character of the dredging to be done on the Hooghly. The hull and machinery are constructed to Lloyd's highest class. The main deck is of steel, sheathed with teak. Steam and hand steering gear is fitted, and a very complete installation of electric lighting is provided, including two searchlights.

The propelling and pumping engines are placed in two independent compartments. The propelling power is supplied by two sets of triple expansion surface condensing engines, embodying all the latest improvements in marine engine practice, including steam and hydraulic reversing gear, steam turning gear, independent circulating pumps, automatic feed pumps, feed heaters and filters, large evaporators for feed water make up, and a complete outfit of auxiliary feed and bilge pumps. Steam is generated by four large single-ended horizontal multitubular boilers, constructed to Lloyds rules for a working pressure of 180 lbs. These boilers are designed with ample surface for burning Bengal coal under forced draught. An ash ejector is fitted in the stokehold. The pumping outfit, placed forward of the hopper in an independent engine room, consists of one set of triple expansion engines, with independent condensing plant and circulating pumps, complete with all modern fittings. The pump engines are coupled direct to a centrifugal sand pump specially designed to raise and discharge about 5,000 tons of sand and silt per hour. The pump is connected to a suction pipe, placed in a well at fore end of the vessel, being fitted at upper end with a massive swivel bend, which serves as a trunnion or hinge upon which the pipe is free to move vertically. The suction end of the pipe is fitted with a specially designed nozzle to suit the character of the material to be dredged while a gird is also fitted to the nozzle to exclude material which might choke or damage the pump. The suction pipe is controlled by a steam winch placed on deck.

Auxiliary Equipment

The discharge pipe from the sand pump is carried aft of the hopper.

One of the outstanding features of the deck equipment of this dredger is the extensive and powerful installation of mooring winches to regulate the movements in the rapid currents of the River Hooghly.

The bow winch has four large independent wire rope drums for working long lengths of heavy steel wire rope. The winch is driven by a vertical high pressure engine, the gearing throughout being of steel. In addition at bow a very massive windlass is fitted, having four independent cable-holders and two warping ends. At the stern a large windlass is fitted having two independent cable-holders and two warping ends of extra large dimensions.

A large workshop is fitted under deck so that all general repairs may be effected on board. The outfit of machine tools is very complete, and consists of lathes, shaping machine, radial drill, etc., also smith's forge, with mechanical fan, all driven by electric motors.

The Balari has been constructed under the direction of J. Angus, engineer and London agent to the Calcutta port commissioners, assisted by Robert Anderson, Renfrew, resident inspector.

Passenger Steamer Noronic

The passenger and freight steamer Noronic, building for the Northern Navigation Co., at the Port Arthur yard of the Western Ship Building & Dry Dock Co., was launched on June 2. The steamer is built on the Isherwood system up to the spar deck and is of the following dimensions:

Length over all	385 ft.
Length between perpendiculars..	362 ft.
Breadth, molded	52 ft.
Depth	28 ft. 9 in.

There are seven hatches on main deck, five forward of passenger gangway and lobby and two aft.

There are four holds for cargo separated by watertight bulkheads to main deck in addition to the usual watertight bulkheads at peaks and coal bunkers.

Entrance to the vessel is by five 7-ft. gangways with the usual double doors as now fitted on package freighters, in addition to the passenger and engine room gangways.

A full equipment of cargo-hoisting gear of the standard line shaft and double friction drum type, serving all hatches with two 12 in. sq. high-pressure engines.

The cabin accommodations and finish are as per this company's practice, being an improvement on the other vessels.

There will be 600 first class passengers and seating room for 300 in a 102 ft. and 46-ft. dining room.

The observation room is located so that passengers enter it on leaving the dining room.

This vessel has five decks, viz.: Main deck, 14 ft. 6 in. above the tank top; spar deck, 10 ft. above main deck; promenade, observation and boat deck, 7 ft. 8 in. apart, and wood deck house, 7 ft. 3 in. above boat deck.

The height from the keel to the bridge is 62 ft. 6 in.

All the steel above the spar deck is arranged in the usual way.

The propelling machinery consists of a four-cylinder, triple-expansion engine, 29.5, 47.5, 58 and 58 in. cylinder

diameters by 42-in. stroke, 3,500 I. H. P. The propeller is cast steel, four-bladed, 16 ft. 6 in. diameter and 17 ft. pitch, with a surface of 87.25 sq. ft.

Steam is furnished at 200 lb. working pressure by four Scotch boilers, 15 ft. 6 in. diameter and 11 ft. 6 in. overheads, and one auxiliary boiler, 12 ft. 5 in. diameter by 11 ft. 6 in.

These boilers have two-piece shells, being without seams. Each main boiler contains three 42-in. furnaces and the auxiliary two, and 452 by 2.75-in. tubes in main boilers and 296 in auxiliary.

Total heating surface, 12,128 sq. ft.; grate, 300 sq. ft.

The boilers are fired from fore and aft with bunkers at both ends and fitted with Howden draft.

The auxiliary equipment is most complete. In addition to the stokehold ventilation provided by the fan for the draft system, which draws from the stokehold the air being supplied by large down-comers in the stack casing giving a cool, comfortable fire room. There are two large fans provided especially for firehold ventilation at times when the draft system is not in operation, as in port. The draft fan can also draw from the engine room when desired. Two ballast, two bilge, two feed and hot and cold water pumps are fitted.

The electric lighting system is in duplicate and a 10-ton refrigerating plant is installed.

Bridgeport and Glacebay

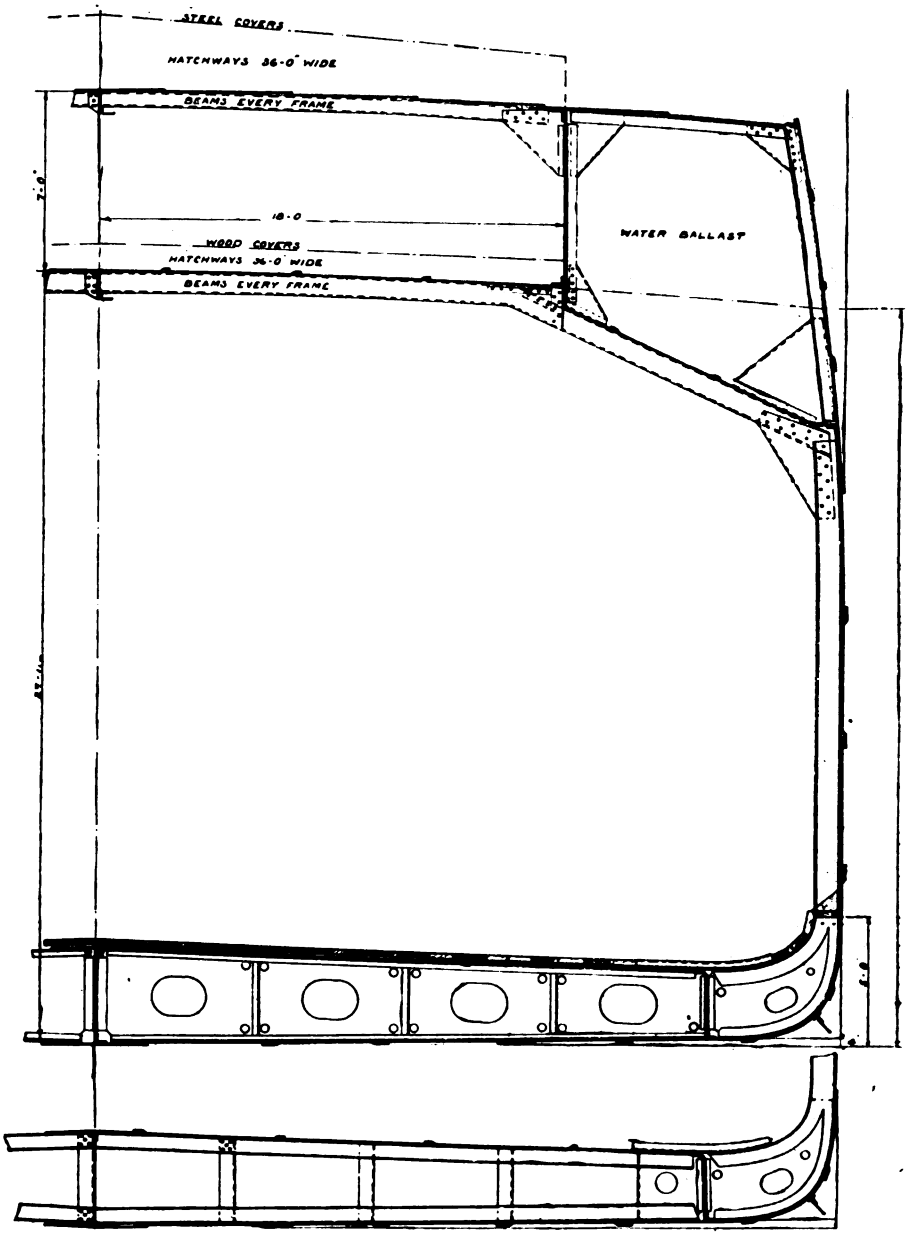
A Type of Ship Particularly Adapted for the Carriage of Heavy Bulk Cargoes

THE steamers Bridgeport and Glacebay, built by Messrs. William Doxford & Sons, of Sunderland, for London owners, constitute a type of ship particularly suitable for the carriage of heavy bulk cargoes, such as coal and ore, in trades similar to that of the Dominion Coal Co., for which the vessels were primarily designed. For the description and illustrations, herewith, we are indebted to *The Ship Builder*, Newcastle-on-Tyne. A leading feature of the two steamers is that wing ballast tanks have been provided on each side for nearly the full length of the shelter 'tween decks. These tanks secure a satisfactory immersion of the ship in ballast condition, and also permit the adoption of hatchways of exceptional size and large holds free from all pillars, owing to the presence of the strong girders formed by the wing ballast tank sides.

The leading particulars of the vessel are:

	Ft.	In.
Length overall	458	0
Length B. P.	442	9
Breadth extreme	58	0
Depth mid. to upper deck	28	9
Depth mid. to shelter deck	35	9
Load draught	25	0
Load deadweight, tons	11,000	
	Cubic ft.	
Grain capacity, holds	430,600	
Grain capacity, peaks	11,400	
Grain capacity, shelter 'tween dks.	97,500	
Total	539,500	
	Tons.	
Capacity of permanent bunkers	710	
Capacity of water ballast tanks:—		
Double bottom	1,310	
After peak	35	
Fore peak	260	
Wing tanks	1,820	
Total	3,425	

The general arrangement of the ships is shown in Fig. 1, and their structural design by the midship section given in Fig. 2. The shelter 'tween decks being exempt from tonnage measurement, the vessels have a



MIDSHIP SECTION OF THE BRIDGEPORT

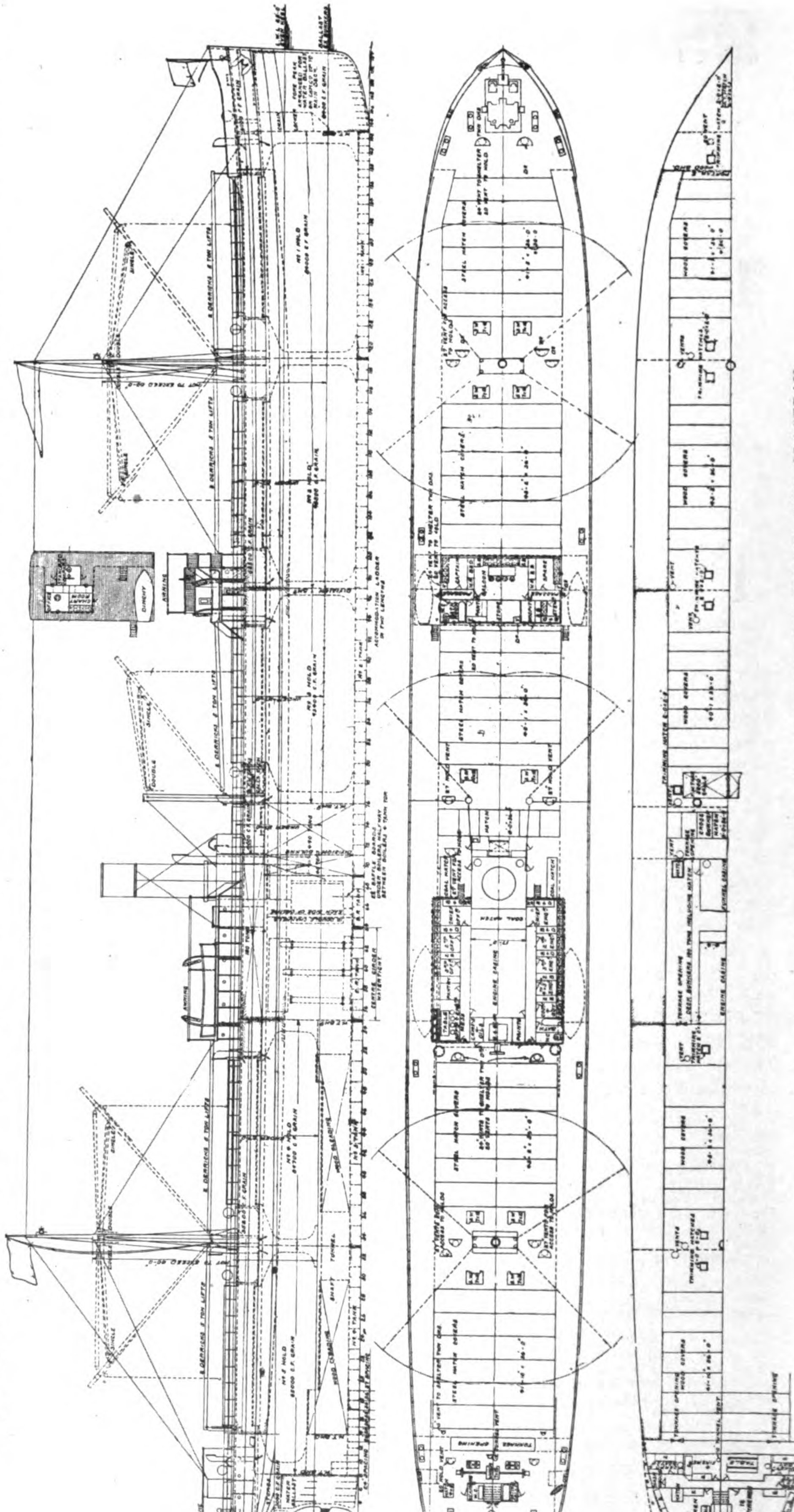
very favorable net tonnage in relation to their deadweight. It will be seen from Fig. 1, that there are five cargo holds, each provided with a hatchway 35 ft. wide by more than 40 ft. long. The hatchways on the shelter deck have steel covers, while the corresponding openings on the upper deck have wood covers. Deep frames of channel section, spaced 37 in. apart for the greater part of the length, support the side plating. In conformity with the latest practice for transverse-framed cargo ships, no side stringers are fitted, and the double bottom floors are placed at alternate frames. Deep vertical web girders are arranged on each side of the transverse bulkheads in line with the wing ballast tank sides and similar webs are fitted at the center line, all these webs having large knees at the top and bottom. The top knees of the center webs support the pillars which carry the end coamings of the shelter deck hatchways.

The loading and discharging appliances consist, at each hatchway, of two derricks, each capable of lifting 5 tons, and two 7 x 12-in. winches, so that there are 10 derricks and 10 winches altogether for cargo work, while an extra 7 x 12-in. winch is provided aft for warping purposes. The derricks of the two foremost and the two aftermost holds are supported from the masts, while those at the midship hold are supported by derrick posts. Two of the ventilators to each hold are utilized to provide access to the portion below the upper deck, and on this account are made 27-in. diameter.

The saloon and captain's accommodation is arranged in a deckhouse, 20 ft. long by 36 ft. wide situated on the shelter deck between the hatchways to Nos. 2 and 3 holds. On top of this house is placed the chart and wheelhouse. The officers and engineers are accommodated in steel houses arranged at the sides of the engine casing. The crew are berthed aft in the after end of the shelter 'tween decks.

The propelling machinery in each vessel consists of one set of triple-expansion engines having cylinders 28½, 47 and 78 in., by 54-in. stroke, and driving a single screw. The boilers are of the ordinary cylindrical multitubular type. The engines and boilers were also built by Messrs. Wm. Doxford & Sons, Ltd.

The Newburgh & Fishkill Ferry Co. has given contract to the I. S. Marvel Ship Building Co., Newburgh, N. Y., for a ferry boat to be a duplicate of the Duchess now in service.



SECTIONAL VIEW OF THE SHELTER DECK CARGO STEAMERS BRIDGEPORT AND GLACEBAY

Isherwood System of Construction

The Bulkhead Construction is Quite Similar to That of the Ordinary Type

By Robert Curr

THE bulkhead construction by this system is no different than that of the ordinary method, only care must be taken to see that a suitable number of rivet holes are punched in the bulkhead at the longitudinal endings.

The plans shown here represent the bulkheads of importance and the rivet markings show the necessary number of rivets at the longitudinal ends, which will be referred to later on.

Bulkhead No. 2 is the collision bulkhead and is very important in case of collision and is useful for trimming vessel as well as prevent pounding when the vessel is light.

This bulkhead is composed of 12.5-lb. plating and stiffened with channels 6 in. by 3 in. by 15 lb., running vertically, spaced to suit the longitudinals on deck.

On the third longitudinal below the spar deck the fore peak flat runs straight across the bulkhead, forming a stiffener horizontally.

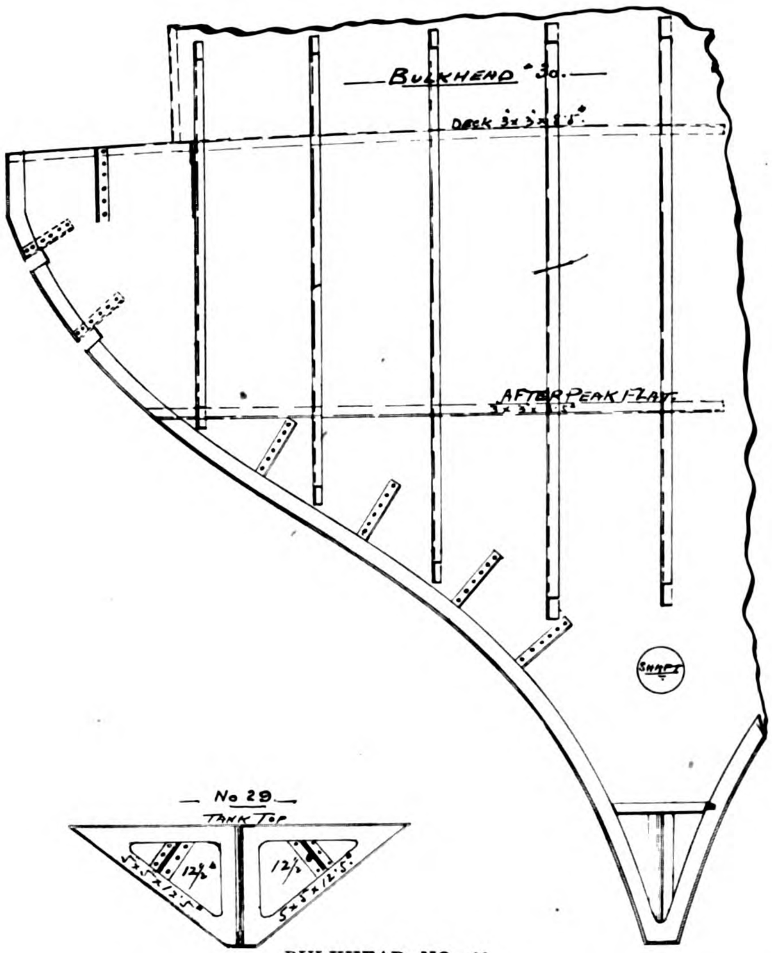
The plating runs vertically and the edges are lapped on the stiffeners shown by bars.

The top of the bulkhead is connected to the deck plating with angles, 3 in. by 3 in. by 8.5 lb., and ¾-in. diameter rivets spaced 4½ in. apart in both bulkhead and deck plating. The riveting is all ¾ in. diameter spaced 3⅜ in. apart in the seams and 5½ in. in stiffeners. The frame forming the ring connecting the bulkhead to the shell is 5 in. by 5 in. by 12.5 lb. and riveted to the shell with ¾-in. diameter rivets zig zag 4 in. apart and 3⅜ in. apart through the bulkhead plating.

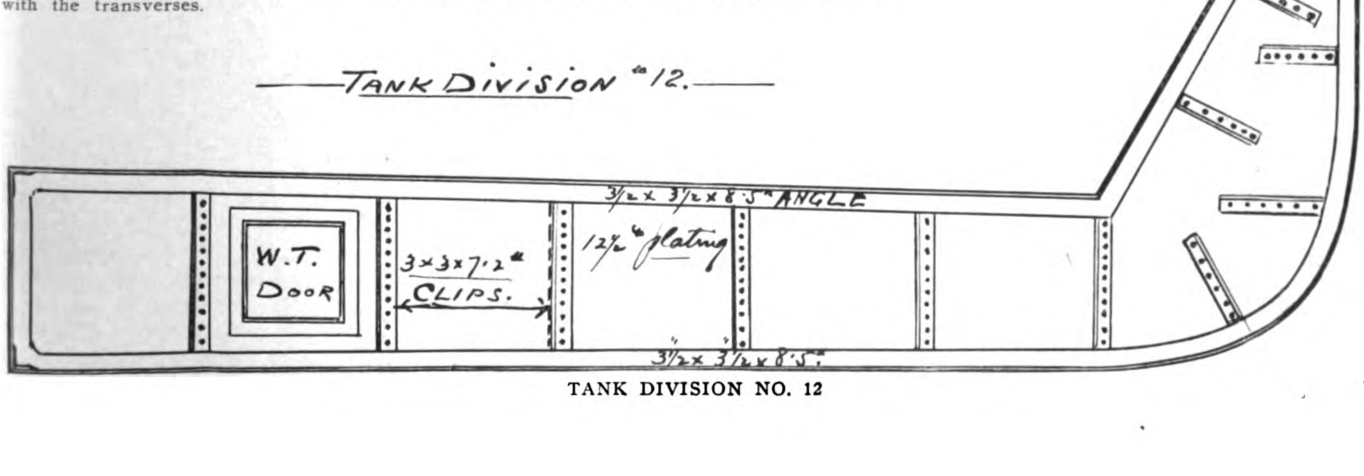
The water bottom is enclosed with 5 in. by 5 in. by 12.5-lb. angles and riveted to the tank top and bulkhead plating with ¾-in. diameter rivets zig zag spaced 3⅜ in. apart.

The tank top at side runs parallel with the sheer, taking the place of N. longitudinal as shown at T. S. N.

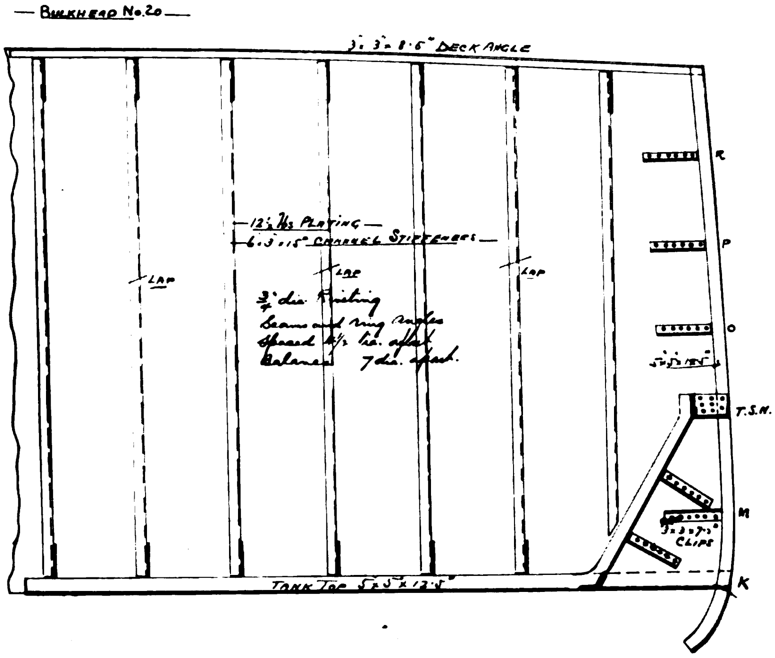
This is the tenth of a series of articles on the Isherwood system of construction which begun in the September issue of the Marine Review. The first article dealt with the general specifications of the steamer, the second with the sheer, half-breadth and body plans; the third explained the method of getting the sheer; the fourth dealt with the longitudinal and transverse framing; the fifth with offsets; the sixth with the shell plating; the seventh with the shell plating expansion; the eighth with the arrangement of plates and angles forming the spar deck and the ninth with the transverses.



BULKHEAD NO. 30



TANK DIVISION NO. 12



BULKHEAD NO. 20

The letters A, C, G, H, K, N, O, P, R are the longitudinal frame brackets showing the number of rivets necessary to compensate for cutting same at the bulkhead. The pocket at the top of the tank at side TSN with nine rivets shows the method of making the tank water tight at this point.

Sometimes it is necessary to get into the tanks when the vessel is loaded and it is done by means of fitting watertight doors on the bulkhead, as shown.

A ballast pipe is run into the fore peak and a valve is fitted on the bulkhead under the line of the tank top to drain the peak.

Tank Division No. 12: This plan shows the after end of No. 1 tank and like the collision bulkhead shows the starboard side; looking forward in the vessel.

The bounding angle is 3½ in. by 3½ in. by 8.5 lb. and is made thoroughly watertight. The angles shown with rivets are for connecting the longitudinals to the floors and the necessary number of rivets are here shown.

The watertight door here shown is for the same purpose as described on No. 2.

On this division the pipe for the fore peak and No. 1 tank passes through, there being two pipes on the one side. Rivets ¾ in. diameter, spaced 4½ in. diameter.

No. 20 is a watertight bulkhead above the tank and is the after end of the hold, there being only one hold considered in the meantime.

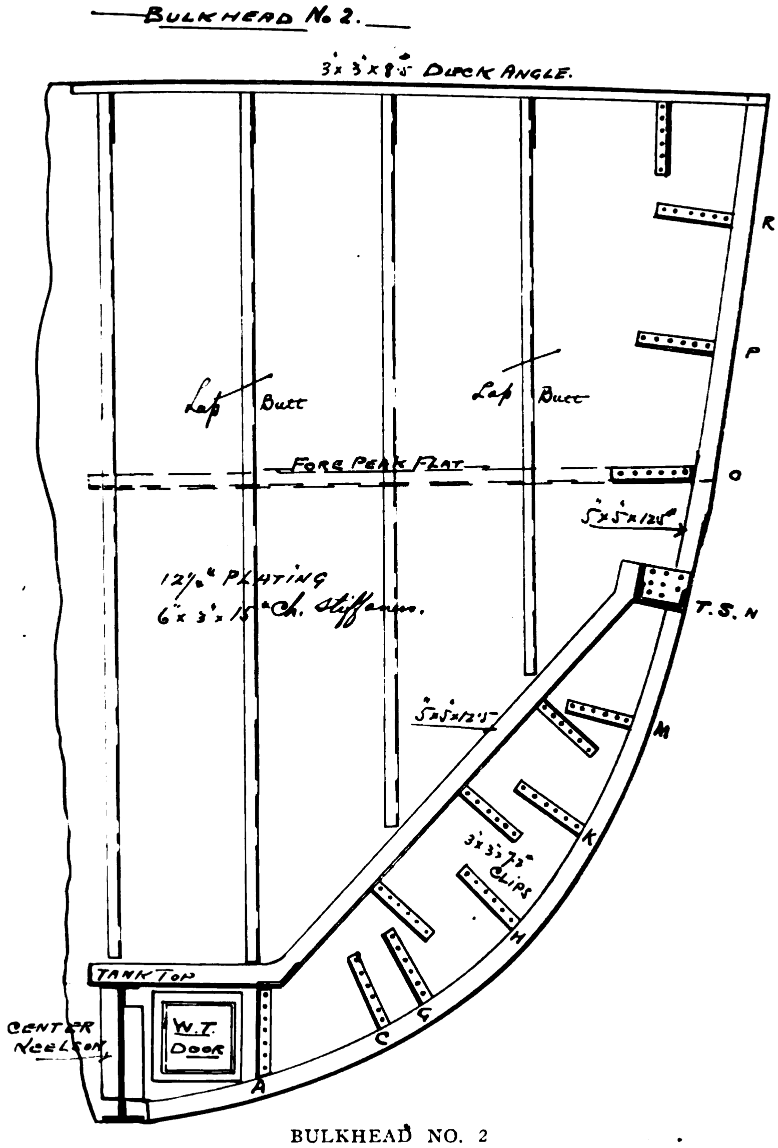
The plating and stiffeners are the same as the collision bulkhead, likewise the rivets and riveting.

The side tank ends at this bulkhead and drops down to 2 ft. 9 in. above the base line. The tank side takes the place of longitudinal K abaft this bulkhead and the bulkhead is made watertight by continuing the margin angle on afterside around and across the bulkhead at K, as shown by dotted line.

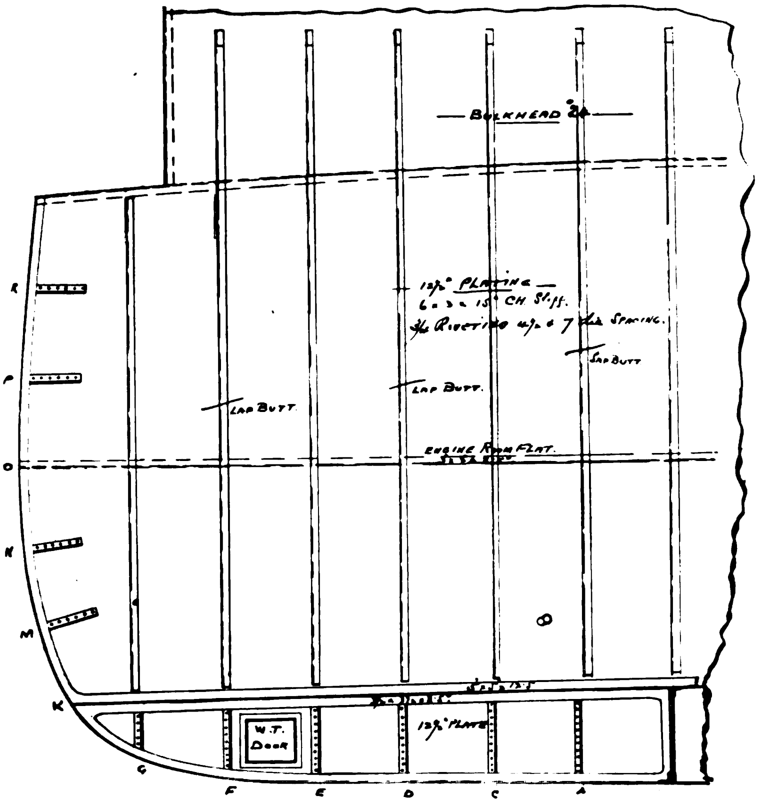
The plan of this bulkhead is shown looking aft and represents the port side of the vessel. The stiffeners are bracketed to the tank top as well as the deck longitudinals. The coal bunker runs from 20 to 21, the bulkhead on 21 being like No. 20, but not watertight, with the longitudinal frames passing through same, the notching out for the longitudinals being made dust tight with plate collars.

The angle for tankside will also be dispensed with on bulkhead No. 21. Bulkhead No. 24 is the engine room bulkhead, and is made watertight, likewise the division in the water bottom. This bulkhead is constructed of the same material as the others and the rivets and riveting are similar.

This bulkhead runs from the tank top to the top of the house on spar deck. Looking aft this bulkhead



BULKHEAD NO. 2



BULKHEAD NO. 24

shows the starboard side of the vessel.

One watertight door will be fitted between the engine and boiler rooms. Two ballast pipes will be fitted on one side of the division and three on the other. Bulkhead 29 is the end of the tank and is composed of two 5 in. by 5 in. by 12.5-lb. angle frames plated over. The double angles shown are for connecting the A longitudinal to the tank end.

Bulkhead No. 30 forms the after peak bulkhead and serves the same purpose as the fore peak. This bulkhead is fastened and the materials are similar to the fore peak excepting around the shaft this bulkhead is doubled.

Steamers Underwood and Cooke Remodeled

The steamers F. D. Underwood and Delos W. Cooke, of the Erie Railroad Lake Line, have undergone a thorough overhauling at Buffalo and all the latest and most up-to-date improvements in package freight ships have been added.

New boilers, fitted with improved smoke-preventing and fuel-saving mechanical draft systems, have displaced the former natural draft boilers; the propelling and auxiliary machinery has been reorganized on the most improved lines, and every provision of assured value in the economic and rapid handling of package freight has been added. The alterations have also greatly enhanced the external appearance of the ships. Attention has been given to the increased comfort and safety of the officers and crew and the reduction of labor in handling ship. In the latter respect alone the abandonment of the customary cumbersome and unsafe manila lines and the substitution in all the ships of the fleet of the comparatively light and easily handled but much stronger steel wire cables handled entirely by fast moving engines not only greatly reduces the port labor of the crew but adds greatly to the speed of handling ship.

On the Underwood two new steel houses have been built forward, containing private accommodations for guests of the line. The forward house contains two large sleeping rooms with bath and toilet between. The after house contains a private dining room with pantry and galley adjoining. The sleeping rooms and dining room are finished in bog oak, the bathroom, galley and pantry in enamel white. A Pullman berth and large davenport in one bedroom convert this room into a day parlor. Unusually large portlights, in ample number, in lieu of windows, supply abundant light.

All the work on these quarters and in fact all over the ships except the building and installing of the new boilers, has been done by the company's own staff in Buffalo.

The Erie ships under the policy of President Underwood of providing a fleet and service second to none have undergone a transformation which has brought forth much commendation.

Coke vs. Oil as Fuel on Steamships

The following report by G. W. Dickie, and published in the Vancouver *Province*, on the comparative costs of coal and oil as fuel on two of the C. P. R. British Columbia Coast Service steamships, is of interest, in view of the number of vessels which have recently been built to consume liquid fuel, or have been changed so that either of the two fuels may be used. The costs of coal and oil for the steamship Princess Victoria are given herewith:

Coal.	Per day.
100 tons at $4.50	$450.00
9 firemen at $55 a month each	16.50
9 trimmers at $45 a month each	13.50
Food for 18 men	7.56
Total	$487.56
Oil.	
344.17 barrels, at 90c	$314.25
6 firemen	11.10
Food for 6 men	2.52
Total	$327.87

The costs for the Princess Charlotte, a larger vessel and of greater horsepower, are as follows:

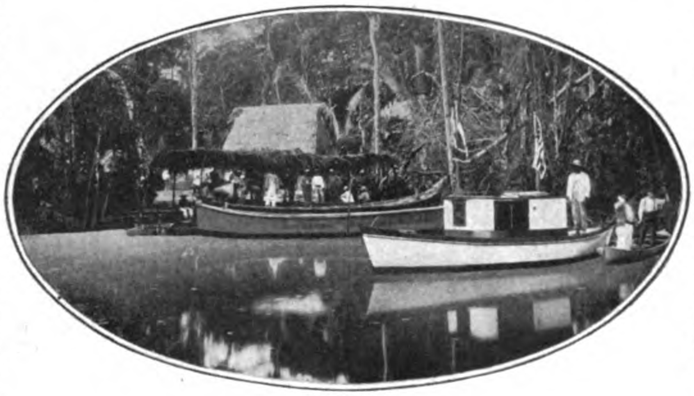
Coal.	Per day.
100 tons at $4.50	$450.00
13 firemen at $55 a month each	23.80
10 trimmers at $45 a month each	15.00
Food for 23 men	9.56
Total	$498.36
Oil.	
344.17 barrels at 90c	$314.25
6 firemen	11.10
Food for 6 men	2.52
Total	$327.87

William Simons & Co., Ltd., Renfrew, recently launched complete with all machinery on board and with steam up ready for trials a 700-ton hopper steamer, being the first of a fleet of eight dredging vessels they have on hand for the naval port, Emperor Peter the Great, now under construction at Reval by the Imperial Russian government for warship purposes. The vessel is propelled by compound surface condensing marine engines, supplied with steam from mild steel horizontal multitubular boilers constructed for a working pressure of 120 lbs. per square inch. Powerful steam gear is provided far rapidly raising and closing hopper doors.

The ice-breaking tug J. I. Horne was launched at Port Arthur, May 9. She is 125 ft. long, 28 ft. beam and 16 ft. deep and is owned by James Whalen.

Heavy Duty Gas Engines

How the Products of the Wolverine Motor Works Are Finding Their Way Into All Parts of the World—Designs by J. Murray Watts



GILDA

THE Lizzie H. is an oyster boat owned by the Sealshipt Oyster System, Greenport, Long Island. She was originally equipped with a steam engine, but two or more years ago this was replaced by a 65-H. P. Wolverine motor, manufactured by the Wolverine Motor Works, Bridgeport, Conn. The Lizzie H. is 72 ft. long over all, 18 ft. beam, 5 ft. 6 in. draught and is of 34 gross tons. The immediate effect of the installation of the gas engine was to increase her carrying capacity by 500 bu. of oysters. She has, moreover, 11 inches more freeboard and can work more comfortably in rough weather than formerly. The motor is of the 4-cycle type, 10-in. bore with 12-in. stroke, developing 65 H. P. at 300 revolutions per minute. Capt. Adolph Johnsen, of the Sealshipt company, says that the engine has run continuously 10 hours a day without causing any trouble, having given perfect satisfaction up to the present time.

Haysport I operates out of the port of New Westminster, B. C., in the fishing trade. Its business is to visit the various fishermen and collect the catch. It was equipped with a Wolverine two-cylinder motor eight years ago. For the past four years it has been operating on one cylinder only, and for economy's sake the owner declares that it cannot be beaten.

The tug Alecia operates in Galveston harbor, being employed by one of the dredging companies. She is powered with a 50-H. P. Wolverine engine.

The power boat Gilda, of which mention has been made in a previous issue. operates in West Indian waters. She is equipped with a 5-H. P. Wolverine engine, and she makes her run of 8 knots in from 55 to 70 minutes.

The Wolverine Motor Works last year installed one of their 50-H. P. Wolverine motors in the Daphne, owned in South Bend, Wash. Capt. H. A. Gracy wrote the following description of the initial trip:

"I will send you a photo of the Daphne for the Wolverine people. There isn't much to tell of the trip from Willapa Harbor. We left Willapa Harbor for Everett, on Puget Sound, a distance of 277 miles, with the launch Daphne, 52 ft. long, 13.7 ft. beam, 4.10 ft. draught, with a brand new 50-H. P. Wolverine engine, which was not run more than an hour before leaving out. We left out on April 30, at 10 o'clock a. m., crossing the bar at 12 m. The bar was breaking and very rough, with a good, stiff westerly wind, and running on the trough of the sea, we rounded the cape at the mouth of Puget Sound at 12 o'clock midnight, reaching Port Townsend about 10 o'clock, May 1. We there stopped the engine for the first time and found her bearings nice and cool as if she had been run a year, finding everything all right. We again started her up to make the run for Everett, arriving in Everett at 3 p. m., making the distance of 277 miles in 29 hours, running the engine at a speed of 275 R. P. M., a little better than two-thirds speed, never missing a shot only when we stopped her. The engine certainly runs fine, and will develop from 10 to 15 H. P. more than any 50-H. P. of any other make on the coast that I have ever run."

Designs by J. Murray Watts

J. Murray Watts, naval architect, 328 Chestnut street, Philadelphia, has designed a number of power boats for commercial or pleasure purposes during the past few months that are either built or building. The 59-ft. power boat Content, with a 50-H. P. Ralaco engine, has just been finished for M. Byron Megargee by the Mathias Yacht Building Co., Camden, N. J. The 76-ft. auxiliary schooner Fareeda, powered with a 75-H. P. Standard motor is being built by the Essington Ship Building Co. This company has recently completed the 60-ft. gunning launch Ponce, equipped with a 50-H. P. Harris motor, for Philip F. du Pont, and the 73-ft. cruiser Howarda with two 37-H. P. Standard motors, for Howard S. Kerner. The Smith & Williams Co., Salisbury, Md., have in frame the 60-ft. schooner Viola II for Marshall M. Jones, of Pittsburgh, Pa., who will use her this summer at Island Heights.

The Camden Anchor-Rockland Machine Co. are building a fast launch with a 25-H. P. Sterling engine for J. Zimmerman and C. E. Brinley, of Philadelphia. The Southern Boat Building Co., St. Michaels, Md., has just completed the 65-ft. steamer York Grange for John A. Bechtel, and expect in a few weeks to have completed the new 42-ft. Jerl II, equipped with a 40-H. P. Lamb motor, for A. F. Wolfe, Wilkesbarre, Pa. The Port Elgin Boat Building Co. are building a 62-ft. twin-screw boat for Fred Magee, Port Elgin, N. B., powered with two Nat oil engines of the English Semi-Diesel make. The Sandusky Portland Cement Co. are building at their own yards a 57-ft. tug with a 50-H. P. Wolverine oil engine. Morton Johnson, of Bay Head, N. J., is putting the finishing touches on the 62-ft. Mione for Charles S. Gardner, to be equipped with a 40-H. P. Sterling motor. The 43-ft. cruiser Virginia, with a 24-H. P. Buffalo motor, has been built from Mr. Watts' designs in Sydney, Australia, for J. D. Williams.

Among the designs now under way, contracts for which will be placed this season, are the 53-ft. cruiser for C. F. Hill, of Philadelphia, with a Standard motor; a 48-ft. cruiser for Chas. A. Van Rensselaer, of New York, with a 30-H. P. Ralaco; a 55-ft. oyster boat for Chas. C. Marshall, of New York, with a 37-H. P. Standard; a 40-ft. day cruiser for L. H. Strouse, of New York, with a 40-H. P. Holmes; two 80-ft. fishing boats for the Southern Menhaden Co., Jacksonville, Fla.; a 74-ft. fishing boat for Alfred Quesnel, of Trinidad; a 73-ft. cruiser for Geo. F. Fish, of Ocean City, N. J., with two 50-H. P. Hall engines; a 60-ft. working boat for Wm. Ford, of the Canadian Venezuelan Ore Co., with two 22-H. P.

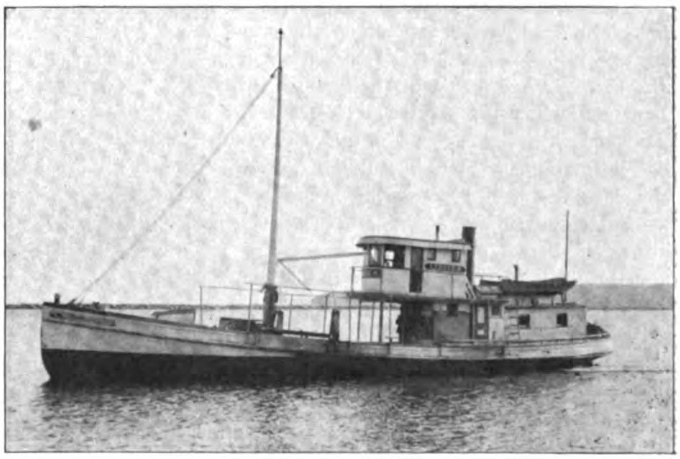
ALICIA

HAYSPORT I.

Mietz & Weiss motors; a 46-ft. cruiser for Chauncey Marshall, to be built by the Black Rock Machine Co., Bridgeport, Conn., and powered with two 36-H. P. Aristos engines; a 40-ft. tunnel stern cruiser for L. S. Clarke, of Philadelphia, with a 40-H. P. Velie engine; a 37-ft. day boat to be built by the Narragansett Bay Yacht Yard for R. E. Paine, of Boston, with a 50-H. P. Sterling; a 56-ft. cruiser for Robt. Shoemaker, Jr., with a 45-H. P. heavy duty Sterling; a 90-ft. auxiliary schooner for A. F. Frenzel, of Denver, Col., for use on the Pacific coast; a 63-ft. cruiser for Wm. P. Burke, of San Francisco; a 62-ft. cruiser for John B. Lomasney, of Tacoma, Wash.; a high-speed 60-ft. cruiser for Harry Maxwell, of New York, with two Standard motors; the 65-ft. Hido for Chas S. McCulloh, of New York, with a 20th Century motor, and the 60-ft. Eclipse for Horace A. Beale Jr., of Philadelphia, with a 50-H. P. Globe motor.

The petrol motor has found its way into all parts of the world, and this is notably the case with regard to its application to marine purposes, as will be evidenced by our illustration showing the boat called Yohmah, recently built in Siam by Howarth Erskine & Co., for the Arracan Co. This boat was designed by Messrs. Thornycroft & Co., of England, who have made a specialty of providing with the complete Thornycroft motor detailed drawings and building specifications, so that a motor boat may, with ordinary care, be built up on the spot. The Yohmah is a boat 30 ft. long by 6 ft. by 1 ft. 10 in. The forward deck is rather shorter than the usual high-speed launch type, and an awning covers the whole of the well, there being a glass screen forward for protection against the weather. Side curtains are fitted all around so that the boat is a very useful one for picnic and camping-out parties. Sliding hatches are fitted to either side of the awning for convenience in embarking and disembarking. The motor is a 30-B. H. P. Thornycroft type, this horsepower being obtained on petrol, but in Siam it is being run on paraffine, a vaporizer being fitted which has given excellent results. The boat attained a speed of twelve miles in the condition as shown with the awning up, which can be considered a very good performance considering the windage this provides. Several boats are now being constructed in Hong Kong and elsewhere all over the world under the arrangement mentioned above, whereby Messrs. Thornycroft supply the complete working drawings, the motor and all fittings, and in view of the high cost of freight in many parts of the world, this practice appears to be one which could be followed with advantage elsewhere.

POWER BOAT DAPHNE



LIZZIE H.

A motor cargo boat, built by John I. Thornycroft & Co., of Southampton, carried through her trials satisfactorily recently. El Lobito, as she is called, has been designed for coasting work off Peru, carrying about 50 tons of cargo which will consist principally of cast iron pipe line. The dimensions of the boat are as follows: Length between perpendiculars, 75 ft.; extreme breadth over rubbers, 16 ft.; moulded depth, 8 ft., and extreme draught, 6 ft. 10 in. The hull has been built on the composite system, having teak planking on galvanized steel framing, and has been built under Lloyds supervision throughout. The decks are of Kauri pine. El Lobito is rigged as a ketch, and is to make the voyage out to destination. Accommodation has been provided aft for officers, consisting of a saloon with sofa seats which can be turned into berths. Two folding cots have also been provided, so that six people can be berthed.

Power Cargo Boat for Peru

The motors are arranged in a separate watertight compartment between cargo hold and the aft accommodation. At the after end of the motor space are paraffine fuel tanks of six tons capacity. The top tank is used to give a gravity feed to the motors, fuel being pumped up from other tanks by a semi-rotary pump. Forward of the motor space is situated the cargo hold, 22 ft. 6 in. long, to accommodate long lengths of pipe. The total capacity of hold is 50 tons. A hatch, measuring 18 ft. 6 in. x 6 ft. 6 in., has been opened in this space to facilitate handling the cargo. An electric and hand winch, designed to lift up to 2 tons, has been fitted on the upper deck forward. Current is obtained from a dynamo fitted in the motor room.

A pitch pine derrick is also fitted on the fore mast for running cargo. A funnel has been fitted abaft the bridge, so as not only to simplify the exhaust arrangements by putting the silencer in the funnel, but to ventilate and also to keep the heat well away from the motor room. The vessel is steered from the bridge by a patent hand steering gear, and is fitted with a hand capstan forward for working the ships' cables.

The machinery consists of two sets of the builders' S/4 type paraffine engines, each having four cylinders, 8½ in. diameter by 12 in. stroke, and together designed to develop 200 brake horsepower at 550 revolutions per minute. A speed of half a knot over the 8½ knots guaranteed was obtained with the engines running at 470 revolutions per minute. An auxiliary set of engines is provided for driving an electric light engine, and an auxiliary air compressor.

POWER BOAT TILLAMOOK

This is only a standby as there is a small compressor on each main engine for charging the starting bottles, and it is only so as to safeguard against the leakage of air when the boat is laid up the auxiliary compressor is required. Reversing is obtained by an epicyclic reversing gear, fitted at the after end of the engine. The whole machinery has been constructed to comply with Lloyds requirements.

Passenger Power Boat Tillamook

The Nehalem & South Coast Transportation Co., of Astoria, Ore., has placed the new power boat Tillamook on the run from Astoria to ports on the Siuslaw river. Tillamook is one of the latest models of the type of freight and passenger gas-driven vessel which is fast becoming quite common on the North Pacific coast, and is expected to do great things toward the development of the little shallow water ports on the Oregon and North Californian coast.

Tillamook is a twin-screw, schooner-rigged vessel, equipped with two 175-H. P. Standard marine gas engines, a 16-H. P. Standard double drum gas hoist and a 9-H. P. Standard gas electric lighting unit, and has auto steering and engine control from the pilot house so that it can be governed by one man. An engine room telegraph conforming to the United States government regulations is also included in the equipment.

There are stateroom accommodations for sixteen passengers with quarters for four officers and forecastle quarters for a crew of five men. Tillamook is 130 ft. over all, 28 ft. bean and has 9 ft. depth of hold. She is built of Douglas fir and Port Oxford white cedar and is a product of the shipyard of Kruse & Banks, of North Bend, Ore.

The steamer City of Montreal, formerly the China, which was considerably damaged by fire at Montreal recently, has been sold to J. H. Hall, Ottawa, by the Montreal and Lake Erie Steamship Co She will be thoroughly overhauled and repaired and will be placed in service between Montreal and Lake Superior ports.

The Navy Department opened bids on May 19, for the submarine tender Bushnell, the lowest bidder being the Seattle Construction & Dry Dock Co., Seattle, Wash.

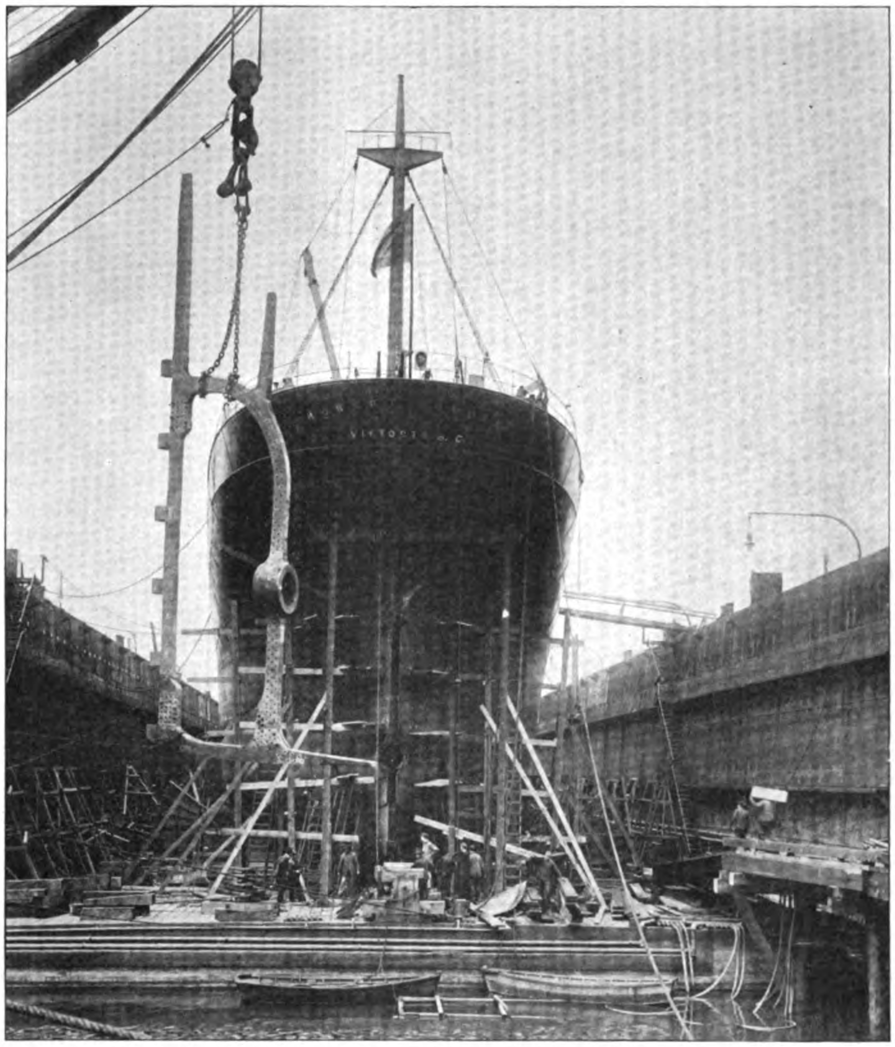
The Kelley-Spear Co., Bath, Me., launched the three-masted barge Irwin, 228 ft. long, 39 ft. beam and 19 ft. deep, for the Pennsylvania Gas Coal Co. of Philadelphia, Pa.

POWER BOAT FOR PERU

Repairs to Robert Dollar

She Stuck on the Columbia River Bar
Necessitating a New Stern Frame

A NOTABLE piece of repair work has just been completed on the large British freighter Robert Dollar by the Seattle Construction & Dry Dock Co., after undergoing repairs since March 16. Bound from Portland, Ore., for China, with a cargo of 5,000 tons of wheat and flour, and a deckload of 1,500,000 ft. of lumber, the Robert Dollar struck the Columbia river bar on March 11. She cracked the stern frame in two places and lost her rudder entirely.



THE ROBERT DOLLAR IN DRY DOCK BEING FITTED WITH A NEW STERN FRAME

Upon being surveyed in Seattle, the extent of the injuries were apparent and it was seen that a new forged stern frame complete, as the photograph shows, would be required. Although no stern frame of such a size had ever before been made on the north Pacific coast, the Seattle Construction & Dry Dock Co. did not hesitate to undertake the work. The stern frame was forged from a 26-in. billet and weighs approximately 12 tons. A new rudder, weighing 14 tons, was also furnished by this plant. The big vessel was lifted easily on the company's new floating pontoon dock.

The experience of the Robert Dollar again illustrates the danger of the Columbia river bar and shows the value of the wireless. While at Portland loading in March the big vessel had a wireless equipment placed aboard. Drawing 25 ft., she struck heavily three times while crossing the Columbia river bar. As she was not making water and was not apparently damaged, the master determined to proceed and consequently set his course for Japan across the stormy north Pacific. However, one of the rudder's pintles had broken and when not more than 100 miles from shore, the other pintles broke, allowing the rudder to drop off. This left the big freighter helpless, in the trough of a heavy sea and with a strong wind blowing. The master, then realizing his predicament, sent a code message to his owners, which no one intercepting could read and take advantage of the information to get a big salvage award.

When the owners in Seattle received the message they immediately hired a tug on a towage basis to pick up the Robert Dollar. As her position was known exactly it was not difficult to find the helpless freighter and within 24 hours the powerful tug was alongside. The tug was dispatched within two hours after the master realized his predicament.

There were difficulties in towing the big freighter into this port. There were strong winds and a high sea to contend with in addition to handling a heavily laden freighter which could not steer. At first the Robert Dollar's engines were utilized but her propeller kept her off the course and later only the tug's power was used. A long cable was cast astern of the steamer and this aided in steering her. Under these conditions it was impossible for the tug Goliah to make more than 3 miles an hour and consequently it was nearly three days before the 200 miles to Seattle were covered.

Upon arriving there the cargo was discharged and it has since been forwarded by the British freighter Volumnia. The Robert Dollar has already begun to load another cargo of 4,500,000 ft. of lumber for China. She is a new vessel, built two years ago at Glasgow, of the following dimensions: Length, 410.3 ft.; beam, 54 ft.; depth, 27.1 ft.; gross tonnage, 5,356, net 4,070. The vessel is owned by the Robert

Dollar Co., of San Francisco. Capt. Dollar is one of the strongest advocates of an American merchant marine, but like many other Americans he finds it more profitable to have his ships built in British yards and registered under the British flag. There is hope that this condition of affairs may some day be changed.

Great Lakes Transportation

Its Great Growth During the Past Decade Reviewed by the President of the Pittsburgh Steamship Co.

At the annual meeting of the American Iron and Steel Institute in New York on May 23, Harry Coulby, president and general manager of the Pittsburgh Steamship Co., delivered an address in which he recounted the wonderful growth lake commerce has made in the last decade and predicted its future growth to be even greater.

The subject allotted to me is "Progress in Transportation on the Great Lakes, and What We May Expect in the Way of Development in the Future." I know of only one standard by which to forecast the future, and, that is, by what has been done in the past. All of you, no doubt, from time to time have read in the trade journals of the increase in the size of ships and cargoes and the increasing yearly movement of freight on the Great Lakes. Statistics are always dry reading, but I know of no other way to graphically illustrate the wonderful growth of this lake commerce than by comparing the tonnage of 1901 (the year the United States Steel Corporation was formed) with that of 1912, a period of 12 years. In 1901, the total movement of iron ore on the Great Lakes was 20,157,000 gross tons, and in 1912 it was 47,435,000 gross tons. I also want to call your attention to one significant fact, and, that is, the percentage of the total movement of the Steel Corporation for its own use was 10 per cent less in 1912 than in 1901, demonstrating very clearly that, even with the large expenditures made by them at Gary and other plants, the other consuming interests of lake ore have grown more rapidly than the Steel corporation.

Growth in Size of Cargoes

The movement of bituminous coal on the lakes in 1901 was 6,533,000 tons. In 1912 it was 23,336,000 tons. Last year the movement of grain was 485,000,000 bushels as compared with 255,000,000 bushels five years ago. The total amount of freight moved through the Detroit river last year was about 95,000,000 tons. In 1901, the average lake freight on iron ore from the head of Lake Superior to Lake Erie ports was 80c per gross ton. In 1912, it was 50c per gross ton. In 1901, the largest single cargo carried on the Great Lakes was 8,222 gross tons, and in 1912, the record single cargo was carried by the steamer Col. J. M. Schoonmaker, 13,511 gross tons. In 1901, the total value of freight moved through the Sault canal was estimated at $298,000,000 as against $791,000,000 in 1912. All this will give you a fair idea of what the growth of lake commerce has been during the last quarter century. It is estimated the movement of iron ore on the Great Lakes this year will exceed 50,000,000 gross tons, or a 150 per cent increase over the movement of 1901. Bear in mind the season of navigation on the lakes does not exceed an average of 240 days, or about 200 working days at the loading and unloading docks. This will require 250,000 tons of ore to be handled every working day in and out of the ships during the season of navigation. The terminal companies have been equal to the demands made upon them. When I first became connected with the business about a quarter of a century ago the ore was loaded into tubs in the hold of the vessel, hoisted up onto a staging with a small engine, dumped into barrows and wheeled into cars, and the task of discharging the largest ship then engaged in the trade, carrying about 2,000 tons, was satisfactorily performed if accomplished in a week's time. Today the record for unloading is 10,636 gross tons taken out of the hold of a ship and put into cars in two hours and 50 minutes. The modern unloading machine is indeed a marvel in engineering skill; electrically operated, and each unit capable of transferring ore from the hold of a vessel into cars at the rate of 400 or 500 tons per hour without the necessity of any manual labor in shoveling the ore; a striking illustration of the elimination of manual labor as in the early days every pound had to be shoveled by hand. Until this type of unloading machine was adopted 50 men were required to do the shoveling necessary to unload a 2,000-ton cargo in a day.

Size of Ships

The new ships that are being built for this trade are about 600 ft. long, 58 ft. wide and 32 ft. deep, built under the arch construction plan, with double sides, triple expansion engines of about 2,000 I. H. P., with an average speed of 11 miles per hour, and burning about a ton and a half of coal per hour. In 1912, the greatest amount of freight carried by one single steamer was 374,000 tons, and the greatest number of miles run by one steamer was 46,835.

If the estimated movement of ore during the present season of navigation is accomplished it will require a weekly movement of iron ore, coal and limestone through the office of the Pittsburgh Steamship Co. (the lake arm of the United States Steel Corporation) of over 1,000,000 tons.

Lake commerce has had a wonderful growth in the past, not equalled in any other locality in the world. The ease and regularity with which it is handled is due to the spirit of hearty co-operation that exists between those engaged in this business; and I know of no greater exemplification of what can be accomplished by co-operation and team work. We are working along the same lines as this institute. Every winter we have a convention attended by representatives of the mining companies, the railroads and terminal companies, the captains and management of the ships, government officials in charge of the canals and aids to navigation, and matters are discussed pertaining to the business. These men get better acquainted with each other and talk over the difficulties that occur in their part of the work, reports of delays and interruptions to the business are made and discussed, and all join together in formulating ways and means to avoid delays and keep the tonnage moving. The question of safety to life and property is also given very serious consideration, and committees are formed to care-

fully watch at all times and make suggestions for the elimination of accidents. We are indebted to the safety committee of this institute for some very valuable suggestions which we find applicable to our business. I know that the results of these yearly conventions are the most important contribution to the development of the business from an economic standpoint.

A Look Into the Future

Now, a word as to the future. The chain of Great Lakes is the greatest inland waterway in the world. A thousand miles from Buffalo in a northwesterly direction, and about the same distance through the Straits of Mackinaw to Chicago, with only three places in the entire distance where channels have had to be widened and deepened, that is, through the Detroit and St. Clair rivers and also through the St. Mary's river, with all the balance of the way practically an open sea on which the largest ships afloat can navigate; with the center of population moving westward and our needs becoming greater every year.

Estimates have been made of the amount of ore that is available in the Lake Superior district, but with new developments each year and the necessity of using the leaner ores, I do not believe there is any man living who can make an estimate that is worth anything of the available tonnage of ore that will eventually be brought down from the Lake Superior district before the ore bodies are exhausted. The other day I was speaking with a practical mining man who had spent his whole life in the iron mines of the Lake Superior region, and it was his opinion that on the older ranges there would be large tonnages of ore found at greater depth. No estimate has been made of the tonnage of what is called low grade ore that would not become marketable until some of the richer ores are exhausted, but the known area of the ore-bearing formation of this so-called low grade material is very large and will eventually come into its own.

I believe the growth of lake commerce will be just as great during the next 25 years as it has been in the past. The country tributary to Lake Superior is rapidly becoming populated, new business for water transportation is springing up every year; large bodies of limestone have been found in the Alpena district on Lake Huron; and this material is now being shipped as far east as Buffalo and also to Chicago and Duluth. The Dominion of Canada is very rapidly contributing to our lake commerce. The northwestern provinces of Manitoba, Saskatchewan and Alberta in the year 1900, produced 43,250,000 bushels of grain. In the year 1912, their production was 453,000,000 bushels, and it is today taxing the railroads to their utmost limit to get this product to the consumer. In fact, in 1911 and 1912, some of this grain was spoiled on account of lack of railroad facilities to transport it. The nearest and cheapest way to get this grain to the consumer is via the Great Lakes to Buffalo, and thence by rail to the sea-board for export.

Will Continue to Grow

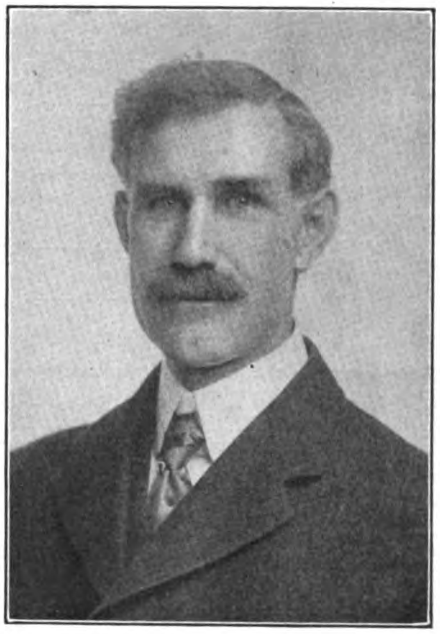
Lake Erie and Lake Ontario are connected by a system of locks in the Welland canal. These locks will only accommodate a boat about 265 ft. long on a 14-ft. draft which restricts commerce to Lake Ontario to boats of this size. Appreciating the necessity of clearing away this obstruction, I understand the Dominion government has appropriated $200,000. for a preliminary survey for a contemplated improvement of $50,000,000, with which it is proposed to straighten and deepen the Welland canal, reduce the number of locks from 25 to 7, giving 30 ft. of water for navigation through the canal available for ships 300 ft. long and 60 ft. wide. Our own government, with great forethought, has realized that every dollar spent in widening and deepening these channels connecting the Great Lakes brings the producer and consumer just that much closer together, and I firmly believe that in years to come either our own government or the Dominion government, or probably both working together, will carry on the work of deepening the channels connecting Lake Erie with Lake Ontario, and Lake Ontario with the Atlantic ocean until the day will arrive when ships will load cargoes of grain at the northwest end of Lake Superior and carry their cargoes to the markets of the eastern hemisphere.

The freight steamer building for the Old Dominion Line at the New York Ship Building Co.'s yards will be named Tyler in honor of the tenth president of the United States. She is 344 ft. long over all, 47 ft. beam and 26 ft. deep and will be ready to go into commission in June.

A. P. Rankin Goes to Manitowoc

A. P. Rankin, of the firm of Logan & Rankin, naval architects and marine engineers, Cleveland, has acquired an interest in the Manitowoc Ship Building & Dry Dock Co., Manitowoc, Wis., and will join that company as assistant manager and chief engineer about August 1.

It is quite safe to say that no man on the chain of lakes is more respected than Mr. Rankin. He was born in Liverpool and received his early training on the Clyde. He was sent to this country by his ship building firm to superintend the installation of a large set of engines built by them for the steamer Cibola, of the Niagara Navigation Co.'s fleet. Upon the completion of this work he concluded not to return to Scotland. While in Canada, he met Robert Logan and went into partnership with him with offices at Toronto and Owen Sound. This partnership was later dissolved and Mr. Rankin entered the employ of the Cleveland Ship Building Co. in 1898. When the American Ship Building Co. took over the plant, as well as many others, Mr. Rankin was appointed chief engineer. He resigned his office in 1911, to enter business again with Mr. Logan, which partnership is now dissolved.



A. P. RANKIN

The Pennsylvania railroad has given contract to the Harlan & Hollingsworth Corporation, Wilmington, Del., for two steel ferryboats for its Philadelphia-Camden service. They will be equipped with two Babcock & Wilcox water tube boilers.

THE MARINE REVIEW

DEVOTED TO MARINE ENGINEERING, SHIP BUILDING AND ALLIED INDUSTRIES

Published Monthly by

The Penton Publishing Company

Penton Building, Cleveland.

BOSTON	Room 510, 201 Devonshire St.
CHICAGO	1521-23 Lutton Blog.
CINCINNATI	503 Mercantile Library Bldg.
NEW YORK	503-4 West Street Bldg.
PITTSBURGH	2148-49 Oliver Bldg.
PHILADELPHIA	611 Bulletin Bldg.
WASHINGTON, D. C.	Hibbs Bldg.
BIRMINGHAM, ENG.	Prince Chambers

Subscription, $2 delivered free anywhere in the world.
Single copies, 20 cents. Back numbers over three months, 50 cents.

Change of advertising copy must reach this office on or before the first of each month.

The Cleveland News Co. will supply the trade with THE MARINE REVIEW through the regular channels of the American News Co.

European Agents, The International News Company, Breams Building, Chancery Lane, London, E. C., England.

Entered at the Post Office at Cleveland, Ohio, as Second Class Matter.

June, 1913

The Straits of Panama

Philippe Bunau-Varilla, the French engineer of the Panama canal following De Lesseps, in an interesting interview in London recently declared the hope that the Panama canal would eventually be made a sea-level canal.

"In view of the recent land-slides," said he, "I favor more than ever sea level rather than lock dam construction. Figures show that the landslides have greatly increased as the work has progressed, but I do not think that this will delay the opening for more than a few days, as the machinery can clear the way, but if the canal were at sea level, the action of the two oceans would speedily dissolve a slide without exception. My hope is that with the machinery on the ground the work will be continued after the opening, so that the canal will gradually be made sea level and thus become the Panama Straits. If not, the canal will be outgrown in a dozen years, for the tonnage of shipping will so increase that the water supply now provided cannot possibly be sufficient."

The distinguished French engineer has greater hopes for the commercial growth of the canal than the ordinary statistician. Gatun Lake contains a sufficient amount of water to provide for 58 lockages a day during the dry season. Obviously during the rainy season there will be water to spare for any number of lockages. All present calculations as to the commercial use of the canal do not contemplate as high as 58 lockages a day for many, many years.

Strange Notions

Some men get very strange notions in their heads and among this class is Congressman Steenerson, of Minnesota, who has now introduced a bill in congress to prevent, according to his own words, "a monopoly in coastwise ship traffic". The purpose of his bill is to permit vessels of foreign register to engage in American coastwise traffic between ports on the Atlantic and Pacific seaboard of the United States through the Panama canal. They would have exactly the same privileges as ships of American register with the exception that they would pay tolls. The present Panama canal exempts American shipping from the payment of tolls. The tolls as at present assessed work out at about 75 cents per ton of freight, which would be more than absorbed in the lower cost of operation under the foreign flag. The Steenerson bill might as well be termed a bill to turn over the coastwise traffic of the United States to the foreign steamship agents. They would do a mighty big business in bringing part cargoes from Europe to the Atlantic seaboard and then filling up with freight destined for Pacific ports.

The American Merchant Marine

There is much confusion in the public mind over the extent of the American merchant marine. The merchant marine that flies the American flag is the second largest in the world. It is considerably larger than the merchant marine of Germany, which is third, but of course, it is infinitely smaller than the British merchant marine, which is first. The total enrollment of American tonnage is about 7,000,000, as against 38,000,000 for Great Britain. It must be understood, however, that the great preponderance of British tonnage is steam, which is reckoned potentially as 2½ times that of a sailing ship. There are a great many sailing ships yet under American register.

We are noting these facts in order that people may understand that the American merchant marine is a considerable industry after all. Unfortunately it is almost wholly confined to coastwise shipping. Foreign ships are by congressional enactment forbidden to enter coastwise or port to port trade of the United States. That trade is exclusively reserved to ships built in American ship yards. It is only when the foreign trade is considered that the American shipping exhibits a lamentable weakness. Every nation is normally and justly entitled to 50 per cent of its oversea carrying trade. The United States has only about 8 per cent of it, the balance of 92 per cent being carried in ships of foreign register.

The chief reason for this weakness in the foreign field is the cost of construction and operation. The American ship has to earn money upon an added cash investment and has, moreover, to pay a higher wage scale and to maintain a higher standard of living.

These conditions make it absolutely impossible for a vessel of American register to thrive in the foreign field. Not at any time during the past 50 years has the American ship been given a chance in foreign trade. The conditions are so inequal that it cannot possibly thrive. In fact, it would not enjoy even the 8 per cent of the foreign carrying that it now has, were it not for the fact that this carrying is mainly to foreign ports contiguous to the United States. There is no hope of a measurable increase in foreign tonnage until the handicaps now imposed upon American shipping are removed or are in some way compensated for. This is not saying that American ship yards are doing no building for the foreign trade. During the past 10 years about $30,000,000 have been expended in American ship yards in the construction of ships for the foreign trade, but when it is considered how vast the American foreign trade is, the sum of $30,000,000 spread over a decade becomes a mere drop in the bucket.

The Panama canal will give American shipping an advantage in reaching ports on the west coast of South America, but beyond that it will not be materially helpful in upbuilding the American merchant marine in the foreign trade unless congress gives additional encouragement. The proper thing to do is to recognize the fact that the American merchant marine is suffering under an artificial handicap and that it should be removed by artificial means. When our foreign marine is normally established and put upon a permanent footing, it will not need help. At present, however, it is very much in need of it.

A Significant Fact

A most significant thing in the address of H. Coulby, president of the Pittsburgh Steamship Co., before the American Iron and Steel Institute last month, was the fact that the percentage of the total movement of iron ore on the great lakes of the Steel Corporation for its own use was 10 per cent less in 1912 than in 1901, when the Corporation was formed. This is a very illuminating fact when taken in conjunction with large expenditures made by the Steel Corporation at Gary and at other places in the enlargement of its plants, because it shows very clearly that the so-called independent consuming interests have expanded more rapidly than the Steel Corporation. The movement of ore on the great lakes in 1901 was a trifle over 20,000,000 tons; in 1912, it was a trifle over 47,000,000 tons, and of this great increase independent interests have consumed most. No single fact could be submitted more convincing than this, that the great growth of the iron and steel trade has been widespread and unfettered.

Great as has been the growth of lake commerce during the past 25 years, Mr. Coulby believes that it will be just as great in the next 25 years.

Of Course

The protest of the various foreign governments against the 5 per cent clause of the Underwood bill has been effective. The protests of foreign governments against any project advanced to benefit the American merchant marine are always effective. Congress lends a very patient ear to any complaints brought forward by foreign steamship interests when any measure is before it that might in any way affect the foreign lines. The clause in the Underwood bill to which the foreign governments objected read as follows:

"That a discount of 5 per centum on all duties imposed by this act shall be allowed on such goods, wares and merchandise as shall be imported in vessels built in the United States and which shall be wholly the property of a citizen or citizens thereof."

Of course, this provision was found to be in contradiction with practically every commercial treaty in existence. Apparently the animating purpose of our statesmen in the formation of treaties is to tie the American people hand and foot every time they get a chance. We do not seem to have a single treaty that is not assigned to the exclusive advantage of the other country.

Capacity of Lake Fleet

The work performed by the lake fleet during May was a revelation of capacity. Not in many years has there been a month beset with so many vicissitudes of navigation. The weather was continuously thick and the upper lakes were filled with floating ice, making navigation slow and extremely cautious. Time was lost at shipping docks, owing to heavy rains, shortage of cars, and everywhere the month was one of trouble, but notwithstanding which the fleet moved over 7,000,000 tons of ore. This is the first time in the history of the trade that the 7,000,000-ton mark has been reached so early in the year. It is a very graphic index of what the fleet is capable of performing under summer conditions. Undoubtedly the movement during the summer months will be in excess of 8,000,000 tons per month. The fleet can move 50,000,000 tons in a season with comparative ease.

At the last meeting of the council of the Society of Naval Architects and Marine Engineers the question was advanced as to why the annual meetings of the society were not better attended by lake representatives. The annual meetings of the society are held during the third or fourth weeks of November, which period is a very critical time in the business of the lakes, and the responsible element does not feel that it can leave during the closing two weeks of the season's business. The society through its council has tentatively put forward the proposition of holding the annual meetings around Dec 11 or 12, provided a better attendance could be obtained from the lakes thereby.

Steamship Congress

The New York Ship Building Co. Launches Its Third Vessel for the Pacific Coast Co.

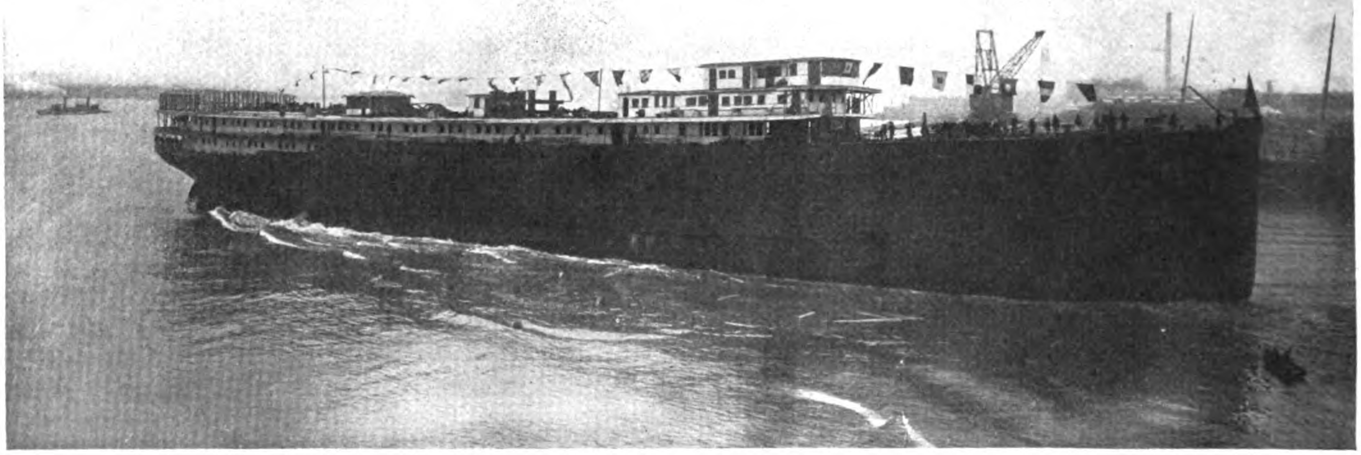
THE new twin screw passenger and freight steamship Congress for the Pacific Coast Co., to be operated, as part of their fleet, by the Pacific Coast Steamship Co., in coast service between Seattle and San Diego, was launched from the yards of the New York Ship Building Co., Camden, N. J., on Saturday, May 17, at 11:30 o'clock. The new vessel was christened by Miss Mary Phelps Jacob, a niece of Mrs. William M. Barnum, the wife of the president of the Pacific Coast company.

The Congress is the largest vessel so far built for the sea coasting trade in this country. She has been specially designed for this service by George W. Dickie, naval architect and marine engineer, San Francisco, who has personally superintended her construction in every detail. Her principal dimensions are as follows:

Length over all 441 ft.
Length, between perpendiculars, 425 ft.
Molded breadth, 54 ft. 9 in.
Depth molded, to upper deck, 29 ft.
Depth of double bottom, 3 ft. 10 in.
Depth to main deck, 21 ft. 2 in.
Main deck to upper deck 8 ft.
Upper deck to shelter deck, 9 ft. 6 in.
Shelter deck to bridge deck, 8 ft.
Bridge deck to boat deck, 8 ft. 4 in.

The vessel, except where the design required special treatment, is constructed of steel in accordance with the A1 20-year rating of the American bureau of shipping for vessels with three decks below a poop and forecastle and a shelter deck. She has a straight stem and elliptical stern, a flat keel and double bottom subdivided by watertight floors and a longitudinal watertight vertical keel plate, fitted complete as water ballast and fresh water tanks. The double bottom extends from the fore peak bulkhead on frame 12 to frame 144, at which point the inner bottom is raised to the top of the shaft alleys or lower deck, except between the alley bulkheads in the center of the ship forming No. 3 hold, where it is continued on the level of the engine foundations to the after peak bulkhead. The wing spaces under the watertight flat outboard of the shaft alley bulkheads are used for fresh water tanks for galley, drinking and lavatory purposes. One hundred and sixty tons of this water is carried. The double bottom extends to the upper turn of the bilge all fore and aft, forming a center line drainage and is raised at the ends as required by the profile of the vessel.

The Congress has two pole masts, rigged as a fore and aft schooner with jib headed sails. There are four main hatches, the two after hatches being trunked through the three passenger decks. No. 2 hatch is trunked between the bridge and shelter decks. This hatch is made large so as to take the longest automobiles, there being room for 24 large cars on the upper deck. There are six side hatches on the main deck and two side hatches in No. 2 hold on the lower deck. There are two Otis elevators in No. 2½ hold. There are 14 side cargo ports and four side passage ports. Four derrick booms are fitted to each mast, the two on the after side of the foremast of steel and capable of handling 15-ton weights. There are eight steam cargo winches, and two steam boat winches. The cargo winches are fitted with machine cut helical gears made by the Andre Citroen Co., and are expected to run without noise.



THE LAUNCHING OF THE STEAMER CONGRESS AT THE YARD OF THE NEW YORK SHIP BUILDING CO.

The lower deck is of steel without covering and no camber. The main deck is of steel without covering except in the refrigerating spaces. At the after end, where third class passengers are berthed, this deck is worked flush and covered with linoleum. The upper deck is of steel and is worked flush throughout. In the stateroom this deck is covered with linoleum also in the spaces aft of the kitchen. In the passages around the boiler enclosures the deck is covered with bitumastic cement. In the main dining saloon, this deck is covered with Dreadnaught tiling, also in the pantry, while the kitchen is laid with special hard tiling. The shelter deck is of steel and is worked flush throughout. In the staterooms this

deck is covered with linoleum and the passages with Dreadnaught tiling. In the holds this deck is not covered. The bridge deck is framed with steel beams the same as the deck below and is plated with steel outside of the deck enclosures and covered with 3-in. pine decking with teak margins. Inside the houses the covering is of 1¼-in. T. & G. pine covered with canvas.

Crew Accommodations

Accommodations have been provided as follows: Deck department, 34; engineers' department, 28; steward's department, 83; miscellaneous, 8; total crew, 153. There are accommodations for 416 first class passengers, 120 second class passengers and 150 third class passengers.

The boat deck is entirely of wood, except certain steel framing under the boats, and is wholly covered with No. 2 canvas. Special steel structures are carried up to take the cargo winches for Nos. 3 and 4 holds and the winches are set on heavy teak beds. The plank sheers and margin strakes round the hatches on this deck are all of teak.

On the boat deck are the following structures: On the forward end of the boat deck, which commences at frame 52, is a structure containing the captain's quarters and the first class smoking room. The captain's room is finished in mahogany and extends the full width of the house, being 26 ft. wide. This room is en suite, consisting of bed room, bath room and reception room. The first class smoking room is in flemish oak and is furnished with toilets and an enclosed bar. The sides of this house have been worked into alcoves with heavily upholstered settees. The flooring is covered with Dreadnaught tiling. The heating, here as elsewhere throughout the ship, is done by electricity. Two large heaters of the luminous type are worked into built-in fireplaces with mantels overhead.

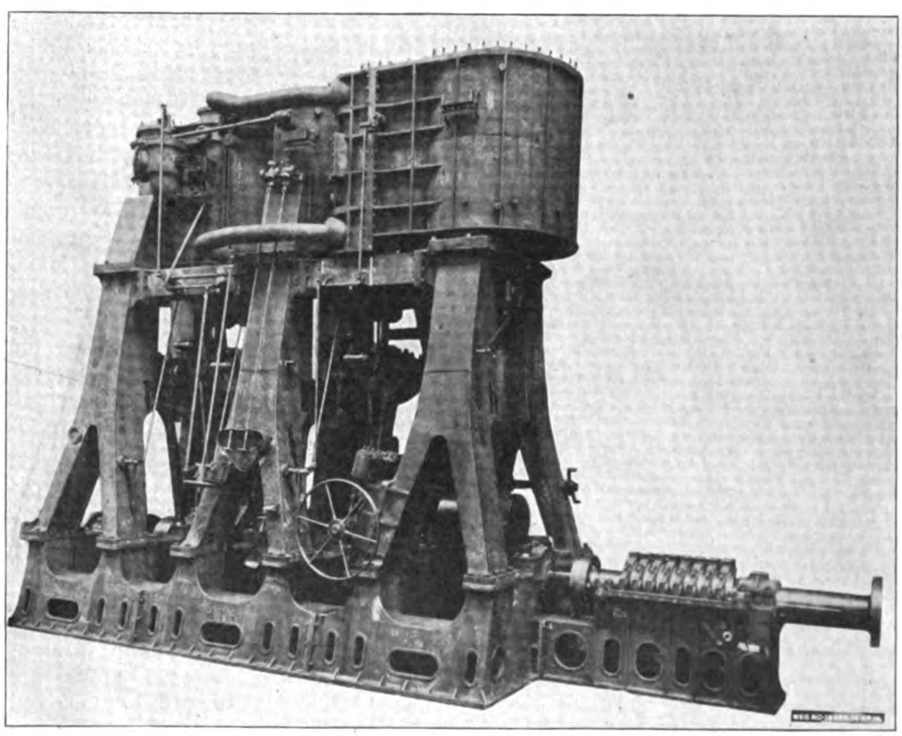
Navigating Bridge

Above the smoking room is the navigating bridge, at the forward end of which is the wheel house. The bridge is entirely closed for a width of 26 ft. with a door on either side opening to the open wings which extend 4 ft. beyond the beam of the ship. Immediately aft of the enclosed bridge is the chart room with officers' toilet and locker and aft of the chart room the quarters for the officers, deck engineer and wireless operators.

Aft of the smoking room and extending between frames 78 and 85 is the forward deck lounge, forming an entrance for the grand stairway which extends down through three decks and terminates in the main dining saloon. This room is finished in quartered oak and is carpeted. The stairway is mahogany and the treads covered with Dreadnaught tiling. Aft of this lounge and also of the uptake enclosures and the special ventilating trunk from the galley is the wireless operating room and office. Aft of the wireless room and the engine room hatch is the after deck lounge extending between frames 140 and 146 and forming an entrance for the after first class stairway. This room is in quartered oak. At the after end of the boat deck between frames 160 and 196 and extending the full width of the deck is the ball room. This enclosure is constructed without stanchions, giving a clear floor for dancing of 35 x 45 ft. Seats are built in around the sides and ends of this room to give the necessary stiffness to the walls.

On the bridge and forecastle deck the house commences on frame 52 and extends to frame 178. Between frames 178 and 180 is a cross passage completing the first class promenade on this deck, while aft of frame 180 and extending to frame 195 the house is continued to accommodate the public rooms for the second class passengers, who have their own promenade extending from frame 180 to the stern of the vessel.

The forward end of the house on this deck is occupied by the first class lounge, a handsome room finished in mahogany and 40 x 48 ft. in size. The forward end of the house is of steel and the sides are worked into bay windows housing window seats. The windows are especially large, being 40 in. in depth. Six fireplaces are built into the finish of this room. Just abaft of the lounge there are four suite rooms with private baths and toilets, two in oak and two in mahogany. Aft of the suite rooms are wide entrance halls from the deck outside, all the rooms opening into the inside corridors or lounges. The balance of this house is occupied by 44 large first class state rooms and two suite rooms with private toilets. The public toilets on this deck, as on the deck below, are in the center of the ship between the two boiler hatches. A vent enclosure at the center line divides them into two sections. All the sanitary piping is run in this vent, which is carried up through the boat deck, where a large exhaust fan draws air from the passenger quarters in the midships part of the vessel through the toilets and then up into the open air above. The second class deck house, aft of frame 180, is occupied by the second class smoking room and the second class lounge, two comfortable and airy rooms. The lounge, which also serves as an entrance to the second class stairway which terminates on the upper deck in the second class quarters, is finished in quartered oak and the smoking room in flemish oak. The staterooms on this deck, as elsewhere



ONE OF THE MAIN ENGINES OF THE STEAMER CONGRESS

throughout the ship, are fitted with large wardrobes and heated by electric radiators. A large parcel and hand baggage room is provided on this deck for the use of the first class passengers.

Forward on the shelter deck are the accommodations for petty officers and crew. The crew's quarters are large and the berths only two high. The passenger accommodations on this deck comprise 84 first-class staterooms and 10 suite rooms. The ship's office is located immediately aft of No. 2 hatch enclosure and is lighted by deck lights from the forecastle deck above. Aft of the office is a large lobby and writing room, 20 x 30 ft. in size. The sides of the vessel are cut away at frame 143 leaving a promenade for the third-class passengers and crew extending from there to the stern. The three classes of passengers carried are thus effectively separated. Aft of frame 184 is the third-class dining room and aft of this again the steering engine enclosure. This deck house is entirely of steel.

The Dining Saloon

Forward on the upper deck are located first a lamp and paint locker, then a carpenter shop on the starboard side and deck store room on the port, then the wash rooms and toilets for the petty officers and crew. From frame 19 to frame 50 is cargo space and is specially designed to carry automobiles, a large number of which are transported on the western coast runs. From frame 50 to frame 85 is the first class dining saloon. This room is entirely fitted with tables for four and accommodates 216. It is finished in mahogany to the lower turn of the cornice and the ceiling is finished white. Deep frames are fitted to compensate for the frames which have been cut in order to form large windows inside the ports. These window frames will be filled with prismatic glass and the deep frames are extended inboard so as to form alcoves. The lighting fixtures here as elsewhere have been specially designed for the ship. Aft of the dining room on the starboard side are the quarters of the steward and his first assistant, the wine room and mess rooms for the firemen, sailors, petty officers and licensed officers and the berthing space for the firemen. On the port side are located the pantry, scullery, butcher shop, baker shop, steam kitchen and galley. In point of size and equipment the culinary arrangements on this vessel are among the most complete afloat. Aft of the kitchen are accommodations for the engineer's crew and the steward's crew occupying rooms. The second-class staterooms are located on this deck. Each room has four berths, two on a side, with 9 ft. 6 in. head room. Here also is the second-class pantry and the second-class dining room, a handsome apartment finished in quartered oak with built-in sideboards. The extreme after end of this deck is taken up with the quarters for waiters and toilets for the second-class passengers. The third-class passengers are berthed on the main deck below and special movable bulkheads are provided in order to extend or curtail the third-class accommodations as required.

Main Engines of Vessel

The Congress is fitted with two sets of triple-expansion, surface condensing engines, with high pressure cylinders, 28½ in. diameter, intermediate 46½ in. and low pressure 78 in. diameter, the stroke being 54 in. The indicated horsepower to be collectively 7,500 at about 86 revolutions. The propellers are three-bladed, turning outboard. The cylinders are independent of each other to allow for freedom of expansion. Hard, close-grained cast iron liners are fitted to all cylinder casings. The valve chests are all in the fore and aft center line of the cylinders. The high-pressure and intermediate pressure cylinders are fitted with piston valves, while the low pressure valve is a double ported balanced slide; each valve chest is fitted with the Lovekin improved assistant cylinder. The high pressure piston is of cast iron and the intermediate and low pressure pistons are of cast steel, and the depth of all pistons on the cylinder surface is 12 in. The high pressure piston is fitted with a solid plug ring, the surface being grooved for steam packing. The condensers are independent of the main engine frames, the total cooling surface being 12,700 sq. ft. The crank shafts are of the built-up type and for each engine are in three interchangeable sections. The reversing gear is of the all-around type, it having advantages for warming up the engines without the danger of moving the ship. This is important where freight is handled up to the last minute.

The air pumps are of the Edwards type, diameter 30 in., stroke 24 in., and, together with the feed and bilge pumps are operated through levers from the intermediate cross head. The auxiliary feed pumps are of the Wier type, the water ends being of composition and extra heavy. There are special ballast pumps, fire, sanitary and bilge pumps, also special fresh water pumps for the distribution of fresh water which is supplied under pressure to every stateroom. There is an automatic oil filtering system fitted. This system collects the oil that has gone through all bearings, pumps it to the filtering system and delivers it back clean to be used over again. There is an auxiliary condenser, feed water heater and filter.

The electric light, heat and power plant consists of three direct-connected, 110-volt, generating sets, each set having a capacity at normal load of 50 K. W., and will stand an overload of 25 per cent for 25 minutes without undue heating. Each generator is directly connected to a vertical cross compound engine. There are about 900 incandescent lamps, two 20 ampere search lights, 10 cargo reflectors, four cargo arc lights, three gangway lights, running lights, a complete electric heating system and 16 motors for fans and kitchen machines.

Boiler Installation

There are 10 single-ended marine boilers, 15 ft. inside diameter and 11 ft. 10 in. inside length, having in all 30 Morrison suspension furnaces, extreme diameter of furnaces 48¼ in. Total heating surface of main boilers 22,116 sq. ft. Four main boilers are fitted in the after boiler compartment and six in the forward compartment. They are placed side by side on each side of the ship and arranged to fire athwartships. The two compartments are separated by a watertight bulkhead. There are also watertight longitudinal bulkheads at the backs of the boilers; these bulkheads are entirely independent of the skin of the ship and are 5½ ft. from the outer plating. The boilers are of the Scotch marine type fitted for natural draft and constructed for a working pressure of 180 lb. Oil fuel is to be used and the Dahl system has been installed. The oil bunkers will hold 7,500 barrels of oil, sufficient for a round trip from Seattle to San Diego and back.

An account of the trials of this vessel will be given as soon as these trials are made.

Charles M. Schwab, president of the Bethlehem Steel Corporation, has announced that the force of the Fore River Ship Building Co. will be increased rather than diminished. No changes will be made in the staff of the old management.

The Richelieu & Ontario Navigation Co. has abolished the position of naval architect, formerly held by A. Angstrom.

Side-Wheeler Washington Irving

The Recently Underwent Her Trials on the Hudson River—Description of Her Essential Features

THE new sidewheel steamer, Washington Irving, built by the New York Ship Building Co., Camden, N. J., for the Hudson River Day Line, made a trial trip on the Hudson on May 14, and went into commission on May 24. The steamer is exclusively a day boat, having no staterooms whatever, and is of the following dimensions: Length, 416½ ft.; beam over all, 84 ft.; depth 14 ft. 2 in.

The steamer's machinery, which was supplied by the W. & A. Fletcher Co., consists of a three-cylinder compound engine of the inclined type, the high pressure cylinder being 45 in. diameter and the two low pressure of 70 in. diameter each, with a common stroke of 84 in. Steam is supplied from six Scotch boilers, four of which are of the single-ended type, 12 ft. 4 in. mean diameter by 11 ft. 11 in. long, and two of which are the double-ended type, 12 ft. 4 in. mean diameter by 22 ft. 2 in. long, fitted with Howden draft and allowed 170 lbs. pressure. The engine is surface condensing and has independent Blake twin air pumps.

The steamer is elaborately decorated, the Irving period being made the basis of interior design. Nineteen parlors with balconies are named from states which existed in Irving's time.

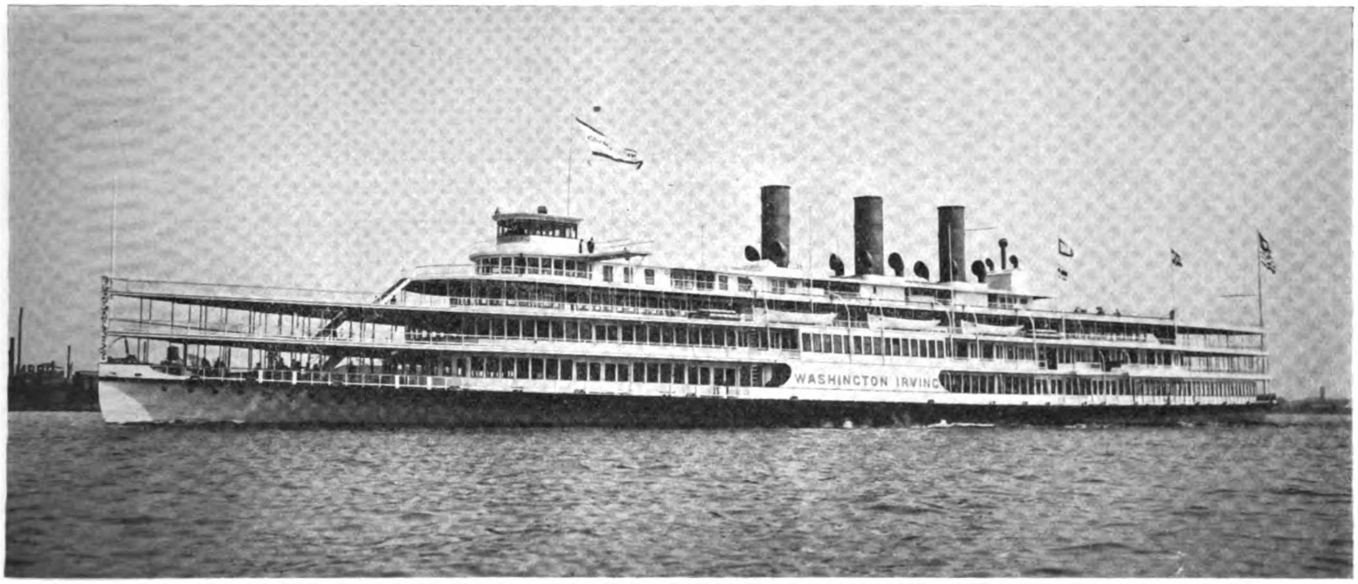
The "Washington Irving" was designed by Frank E. Kirby and J. W. Millard, naval architects. Various models were tested by Prof. Sadler and the architects in the model basin at Ann Arbor and with special reference to obtaining a model that would make as little disturbance as possible in shoal waters and at fast speeds. The torpedo stern was adopted, after these experiments, as showing best results. The results obtained have been most satisfactory, in regards to swell and distance in shoal water.

Hermistor & Sons Bitumastic was used extensively over the inside of hull and in all places which were inaccessible for painting. Also inside and outside of the steel paddle wheel covers. Teak and mahogany were used in such places as experience has shown will rot first. Three-sixteenth-inch plate glass was used in all windows; 14 x 19 port lights were used in every compartment below decks; asbestos board, 3/16-in. thick, made by the Johns-Manville Co. was used for partitions in the crew's quarters, pantry, storerooms, etc.; also for soffits of stairs.

Under side of main deck over quarters, galley, boilers and engine rooms are insulated with asbestos, sheathed with galvanized iron. The five uptakes from the galley, boilers, engine room and steering columns are all steel and all are carried above the superstructure except the latter. Fire lines are laid out so as to give maximum number of nozzles which can be brought to every part of the steamer.

Two Kerr steam turbines are used for generating electricity and United States Standard General Electric armor conduit is used exclusively. Nevasplit board, manufactured by the Keyes Products Co., New York, as well as Agasote and Compo board were used in various places. The Asbestolith Co., of New York, furnished the asbestolith flooring in the dining room and the wainscoating for the entire main and saloon decks. The wire work was done by Hopkins & Co. of New York, the plumbing by Stephen Ransom, of New York. The plate glass was furnished by Sutphen & Meyer, of New York. The interior designs by Louis O. Keil, of Detroit, decorating by Augustus Kruger, of Detroit; the Compo relief decorations by Jungweith & Siebert, of Detroit.

The steamer was launched Dec. 7, 1912, and put in commission May 15, 1913. Her life-saving equipment is 6,200 block cork life preservers and her quota of life rafts and boats.



THE NEW SIDE-WHEEL PASSENGER STEAMER WASHINGTON IRVING, OF THE HUDSON RIVER DAY LINE FLEET

Boats were made at the New York Shipbuilding Co. and the life rafts by the Carley Co.

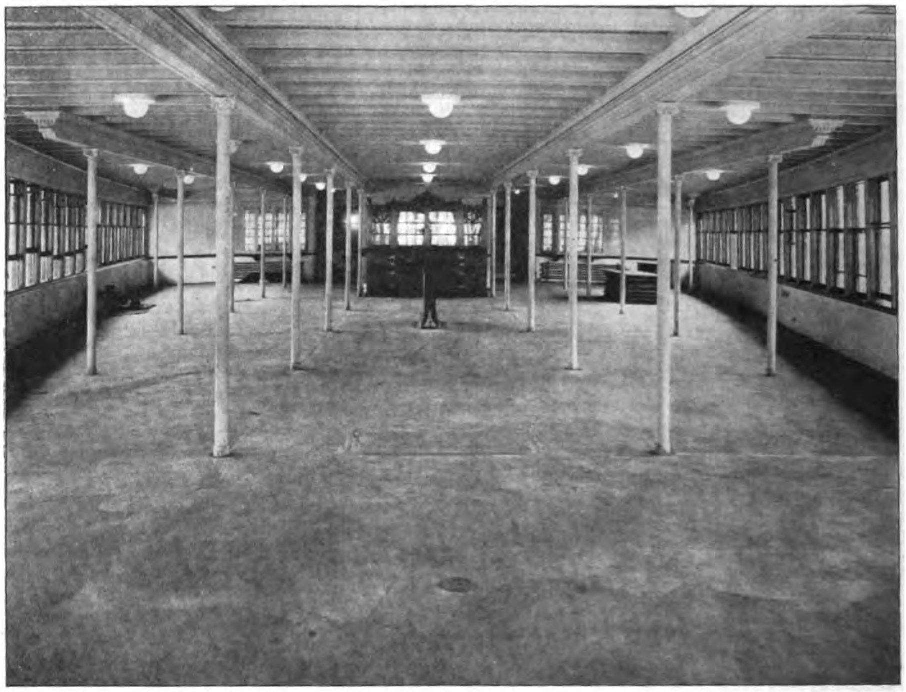
Trim tanks, holding 32 tons, are on every guard and her entire fresh water supply can be carried either forward or aft below. Williamson's steering gear is used. One Hyde steam capstan is used forward and two gypsy capstans at the aft gangways.

Lake Ship Building

R. B. Wallace, general manager of the American Ship Building Co., closed contract in Montreal last month for the construction of a bulk freighter for Canadian interests to be the largest on the great lakes. The new freighter, which will operate in the grain trade, will be 625 ft. over all, 605 ft. keel, 59 ft. beam and 32 ft. deep, and will be built on the Isherwood system of construction. The work will be done at the yard of the Western Shipbuilding & Dry Dock Co., Port Arthur, Ont., which is a subsidiary of the American Ship Building Co. The vessel is intended primarily for the grain trade and has been designed to pass through the Canadian lock, which is 60 ft. wide. This steamer is 8 ft. longer than the steamers Col. James M. Schoonmaker and W. P. Snyder Jr., of the Shenango Steamship Co.'s fleet, but she will have 5 ft. less beam. She is to come out in 1914.

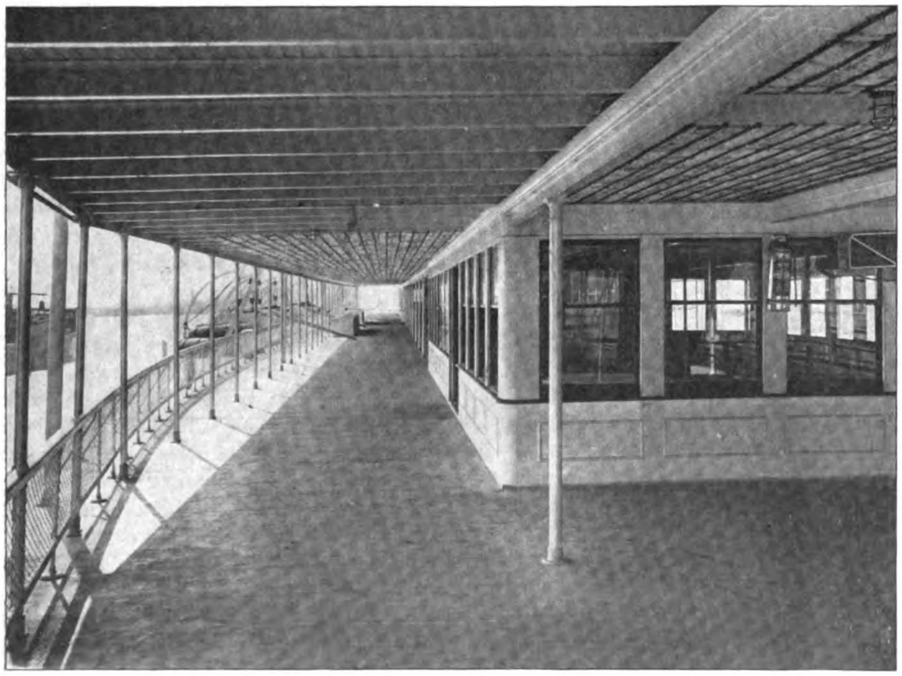
The bulk freighter James Caruthers was launched from the Collingwood yard of the Collingwood Ship Building Co. on May 22 for the St. Lawrence & Chicago Steam Navigation Co., being christened by Miss L. C. Wright, daughter of A. A. Wright, general manager of the company. The general dimensions of the steamer are: Length over all, 550 ft. 8 in.; length between perpendiculars, 529 ft.; beam, 58 ft.; molded depth, 31 ft. She is equipped with triple-expansion engine with cylinders 24, 40 and 66 in. diameter supplied with steam from three Scotch boilers 13 ft. diameter by 11 ft. long, allowed 185 lb. and fitted with forced draft. She is equipped with side tanks and her 31 hatches are spaced 12 ft. centers.

The bulk freighter A. C. Dustin, building for the Cleveland Steamship Co., was launched from the Lorain yard of the American Ship Building Co. on May 17. The Dustin is 545 ft. over all, 58 ft. beam and 32 ft. deep, and is built on the Isherwood System.



DINING ROOM OF STEAMER WASHINGTON IRVING

The ice crushing tug, J. T. Horne, building for the Great Lakes Dredging Co., Fort William, Ont., was launched at Port Arthur on May 10th. The new tug is 125 ft. long, 28 ft. beam and 16 ft. deep, and is to be given sufficient power to keep the harbor open all winter.



PROMENADE DECK STEAMER WASHINGTON IRVING

Sidewheel Steamer Seeandbee

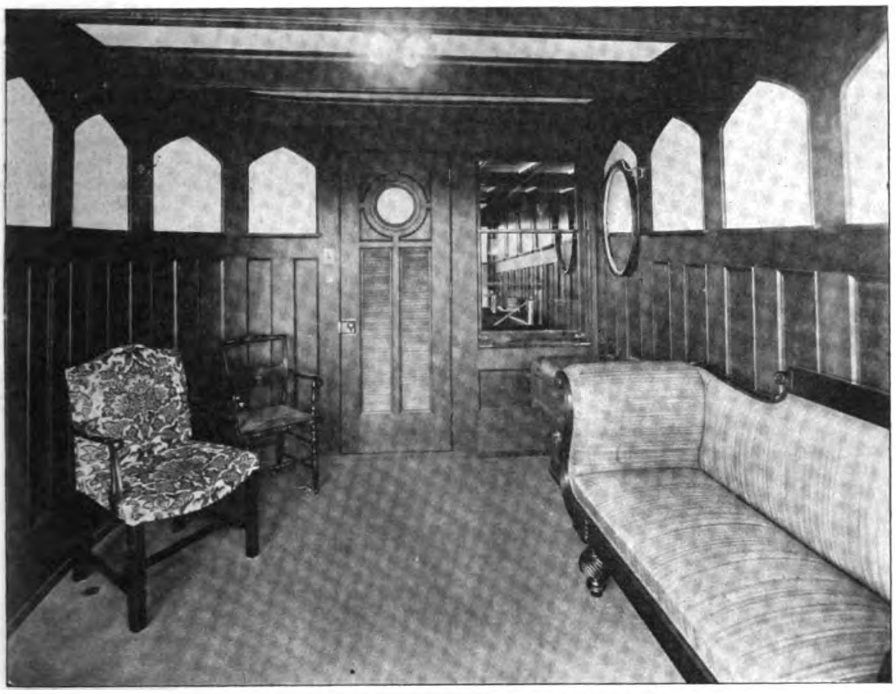
The new sidewheeler Seeandbee left the yard of the Detroit Ship Building Co., Wednesday, May 28, at 7:50 a. m., on her first trial trip. The machinery had been turned over slowly for several hours each afternoon for three days preceding, but due to the great power the engine had to be turned so slowly that little benefit in the matter of wearing bearings down could be expected.

The engines were run at a moderate speed down the river and gradually increased after the compasses had been adjusted and steering gear tried out.

The trip down was to Put-in-Bay and then back to Detroit. On the way back the engines were speeded up gradually until 31.5 revolutions was attained without any difficulty, with 30 per cent slip in wheels. This would represent a speed of approximately 23 miles, but owing to the shoal water and no attention being paid to distances, this cannot be verified, but a speed consid-

erably over 22 miles was attained without any forcing.

The novel application of Walschaert valve gear with single eccentric in connection with poppet gear on high pres-



A DAY PARLOR, STEAMER WASHINGTON IRVING

sure and Corliss gear on low pressure was a complete success and showed a decided advantage over the Stephenson link for this type of machine. The easy reversing of the engine was much commented on and the range of cut-off is so great that with main throttle wide open engine can be stopped with the cut-off. The range at high pressure engine is from 0 to 65 per cent; low pressure, from 20 to 65 per cent cut-off.

The trial was made without the slightest difficulty, the machinery running cool and quiet at all speeds. The engine was handled by Oscar Snyder, of the Detroit Ship Building Co., and Charles Lorimer, chief engineer of the steamer, assisted by J. C. Workman, James P. Hunter, W. R. Donaldson and Geo. Van Haase.

Capt. Hugh McAlpine, master of the ship, navigated the steamer. Capt. A. J. Fox, of the steamer Put-in-Bay, was also aboard, and remarked to Mr. Newman that it was the quickest trip he ever made up the Detroit river in his life. Frank E. Kirby, designer of the steamer, was greatly pleased with the performance of the new boat. The representatives of the Buffalo Transit Co. were T. F. Newman, M. A. Bradley and C. C. Harris.

The builders were represented by M. E. Farr, president Detroit Ship Building Co.; J. C. Workman, chief engineer American Ship Building Co.; Frank A. Jeffries, general superintendent Detroit Ship Building Co., and John D. Langall.

Other guests were Prof. H. C. Sadler, of the University of Michigan; Anderson Mac Phee, chief engineer of Schutte & Koerting Co., Philadelphia, and Mr. Cone, of New York, who supplied the fire alarm system for the ship.

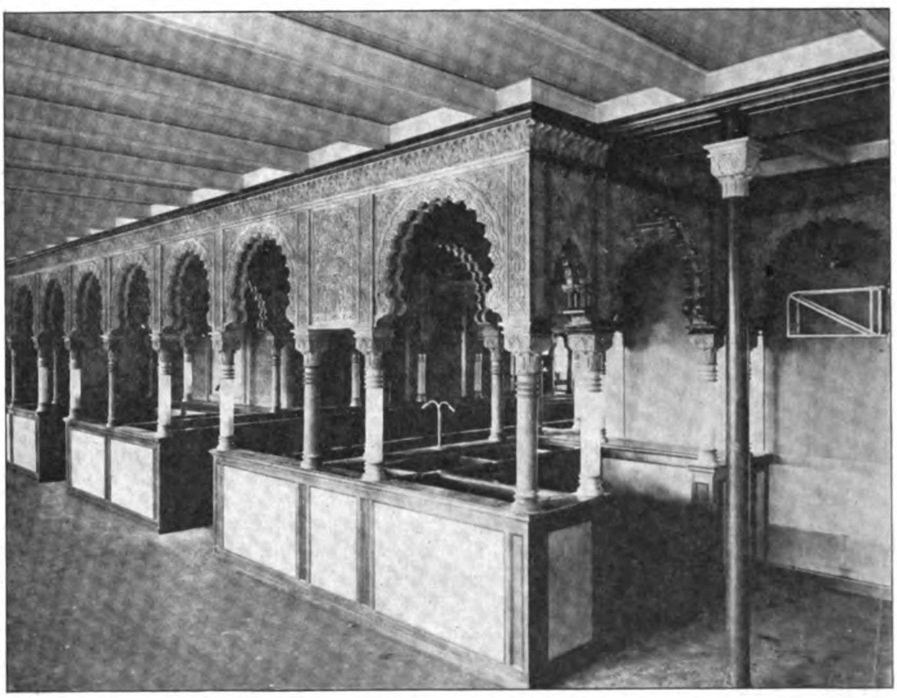
So successful was the trial that no other test will be required, and the steamer will be fitted out and be ready for inspection by the people of Detroit on June 18. She will take the Cleveland Chamber of Commerce to Cleveland on the evening of June 19 and will be open for inspection to the citizens of Cleveland from 2 to 5 p. m., June 19.

Alterations to the Chemung

The steamer Chemung, of the Erie Railroad Lake Line, is at the Cleveland yard of the American Ship Building Co. undergoing extensive alterations, including new boilers, remodeling of engines, new house, modern mechanical heated draft equipment and new cargo handling apparatus. When she reappears in Buffalo about August she will be known as the George F. Brownell, in honor of the vice president of the Erie railroad in charge of its legal department.

The Chemung was built in Buffalo in 1888 and she and her sister ship Owego, built here the year previous, were probably the most noted pair ever built on the great lakes. For years their speed was not even approached by any freighters on the lakes and their record runs between Buffalo and Chicago are still unbeaten.

They are still looked upon by marine men as the handsomest specimens of naval architecture among the great freight fleet of the lakes and still retain their supremacy in speed, as the Owego demonstrated only last year in covering the distance between Chicago and Milwaukee, 85 miles, in 5 hours 7 minutes, or 16.6 miles per hour. An interesting collateral feature of this performance, as disclosed by the management, is that alterations to the Owego, a year ago, along the same lines as about to be carried out in the Chemung, reduced her coal consumption per trip 100 tons, or about 36 per cent.



WRITING ROOM OF STEAMER WASHINGTON IRVING
Copied from the Alhambra

Recent Developments in Life Preservers

A development in the form of construction of life preservers that bids fair to have an important bearing on such equipment, and one which is of particular interest to all followers of the water, either for pleasure or for business, in surf bathing, or otherwise being placed in positions liable to drowning accidents, has been brought out by Lieut. S. P. Edmonds, United States revenue cutter service, retired, Baltimore, Md. He has studied the

LIFE PILLOW

problems in an analytical way and has succeeded in producing results that have been accepted by the patent office as patentable, and patents have been issued within the past year.

The objects aimed at were to provide a life preserver that will apply buoyancy at the head and shoulders instead of at the waist; to maintain its buoyancy and security to the person up to the time really needed, that is, the

LIFE MATTRESS

time of exhaustion; to be applicable quickly without being obliged to wear it; that is, to be able to quickly and easily put it on while lively in the water, then when exhaustion comes, the life preserver will do its important work, instead of slipping from weak hands. Lightness, strength, long floating reliability, ease of putting on, are all aimed at in the new life preserver, which is filled with the wonderful water resisting and light material known as Kapok.

Lieut. Edmonds is also the inventor of the life saving mattress successfully demonstrated before government officers several months ago and which has received wide-spread attention both in the United States and foreign countries.

The principles of the patent life preserver and mattress are easily applied to all boat cushions, chair cushions, hammock mattresses, etc., to be made for vessels.

Iron Ore Shipments

The May movement of iron ore on the great lakes is certainly an example of what the fleet is capable of doing. Navigation was beset with many difficulties during the month; weather was uncommonly thick and ice was met with until well after the middle of the month, in addition to which heavy rains delayed shipment from the mines; yet over 7,000,000 tons were moved. This is the first time in the history of the trade that the 7,000,000-ton mark has been reached during May. The nearest approach to it was in May, 1910, when 6,081,358 tons were moved.

The movement for May was 7,284,212 tons as against 5,919,074 for May, 1912, an increase of 1,365,138 tons. The movement to June 1 totals 8,150,599 tons as against 6,123,116 tons to June 1, 1912, an increase of 2,027,483 tons. It can therefore be seen that no difficulty whatever will be experienced in moving over 50,000,000 tons during the present year. The June movement will probably be a record-breaker as the ore is coming forward fast from the mines and tonnage is abundant.

Following were the shipments by ports:

Port.	May, 1912.	May, 1913.
Escanaba	712,359	738,158
Marquette	356 914	489,547
Ashland	513,484	681,460
Superior	1,931,307	2,047,396
Duluth	1,276,027	1,939,848
Two Harbors	1,128,983	1,387.803
	5,919,074	7,284,212
1913 increase		1,365,138

Port.	To June 1, 1912.	To June 1, 1913.
Escanaba	792,889	955,187
Marquette	356.914	527,041
Ashland	521,772	734,941
Superior	1,995,723	2,300.271
Duluth	1,294,264	2,100,220
Two Harbors	1,161,554	1,532.939
	6,123,116	8,150,599
1913 increase		2,027,483

Commerce of Lake Superior

The commerce of Lake Superior as measured by the canals at Sault Ste. Marie reached 11,376,195 net tons in May, 1913, which is the heaviest movement on record for May of any year, the nearest approach being May, 1912, when 8,936,693 tons were moved. The movement of grain shows a wonderful increase over that of a year ago through the movement of 1912 of that commodity was practically double that of 1911. Following is the summary of movement for 1912 and 1913, to June 1.

EAST BOUND.

	To June 1, 1912.	To June 1, 1913.
Copper, net tons	19,785	18,910
Grain, bu.	12,995,800	22,193,810
Bldg. stone, net tons	2,282	....
Flour, barrels	1,057,960	1,588,511
Iron ore, net tons	5,546,215	7,308,544
Pig iron, net tons	....	3,759
Lumber, M. ft., B. M.	68,527	77,984
Wheat, bushels	35,496,981	42,059,027
Unclassified freight, net tons	27,817	60,340
Passengers, number	1,662	1,684

WEST BOUND.

Coal, anthracite, net tons	17,848	626,159
Coal, bituminous, net tons	1,653,022	2,890,789
Flour barrels	....	....
Grain, bushels	....	....
Mnfctd. iron, net tons	113.807	85,789
Iron ore, net tons	500	....
Salt, barrels	219,022	181,095
Unclassified freight, net tons	157,598	121,615
Passengers, number	1,970	1,829

SUMMARY OF TOTAL MOVEMENT.

East bound, net tons	7,128.152	9,430,301
West bound, net tons	1,975,459	3,851,449
Total	9,103,611	13,281,750
Vessel passages	3,379	3.767
Net registered tonnage	7,972,292	9,703,397

Lake Erie Ore Receipts

Out of a total movement of 7,284,212 tons of ore during May, 5,378,814 went to Lake Erie ports, distributed as follows:

Port.	Gross tons.
Buffalo	787,814
Erie	59,214
Conneaut	1.070,843
Ashtabula	1,296,409
Fairport	362,702
Cleveland	1,073,816
Lorain	487,170
Huron	80,573
Sandusky	......
Toledo	126,469
Detroit	33,804
Total	5,378,814

The navy department will accept the bid of the New York Ship Building Co., Camden, N. J., for the construction of the destroyer tender Melville. It submitted two alternative bids, one calling for steam turbine machinery with reduction gear and installing tools, machinery and shop outfit, for $1,310,000. The other bid was $1,260,000 and covered the cost of the vessel and machinery, the government to furnish the tools and shop outfit.

The steamers City of Annapolis and City of Richmond, building for the Chesapeake Steamship Co., were launched from the yard of the Maryland Steel Co., Sparrow's Point, Md., on May 31. The new steamers are 277 ft. long, 53 ft. beam over guards and 16 ft. 5 in. deep.

The Yale & Towne Mfg. Co. has removed from 9 Murray street to 9 East 40th street, New York.

Here's Proof From Chicago---

The Chief Engineer of the Masonic Temple Building, Chicago, after using **U S G CO'S MEXICAN BOILER GRAPHITE** continuously for some time, makes this unqualified statement.

"Superior To Anything We Have Ever Used."

And here's his own word for it.

Gentlemen:—

Replying to your inquiry of March 8th regarding our experience with your Mexican Boiler Graphite, would say that we have been using it for some time in several of our buildings and find it to be superior to anything we have ever used in the boiler compound line, both as regards effective work and low cost. It has been especially successful in our largest plant, the Masonic Temple Building, where we are using it in three 260-horsepower Stirling water tube boilers. Trusting this will give you the information you desire, I remain,

Yours very truly,
E. R. White, Engineer,
Willoughby & Co.

The Masonic Temple Building, Chicago

U S G Co's Mexican Boiler Graphite Will "Get" That Scale---

Introduced with the feed water **Mexican Boiler Graphite** will soften old hard scale regardless of its thickness or age, so that it will either break down of its own weight or may be easily removed.

Then after the boiler has been thoroughly cleaned of its accumulation of old scale, the continuous use of **Mexican Boiler Graphite** will prevent the subsequent formation of that hard rock-like scale so difficult to remove.

U S G Co's Mexican Boiler Graphite does this work by **mechanical** action and unlike chemicals or "compounds" does not attack or "pit" the metal of the boiler, for any compound of sufficient chemical strength to remove and prevent the building of scale is necessarily strong enough to attack the metal of the boiler. Hence the great advantage of GRAPHITE which acts in a manner **gently mechanical** rather than **chemically severe.**

U S G Co's Mexican Boiler Graphite, acting mechanically, is effective in any feed water regardless of its character, eliminating the necessity of frequent and expensive water analyses, and being insoluble cannot, under normal conditions, carry out of the boiler with the steam. It is the **one** scale remedy that may be safely used in the boilers of Ice plants, Packing houses and Breweries or by any other plant where the live steam is utilized in the manufacture of their products.

U S G Co's Mexican Boiler Graphite is the **original** Boiler Graphite—has a record and reputation—is backed by a thoroughly reliable Company—has made good. Write today for our booklet. Complete details are at your command—ACT. *Put up in 100 lb. kegs and barrels (about 400 lbs.) Quotations on request.*

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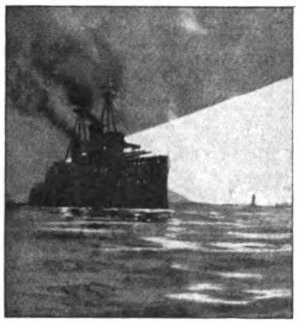

Dimensions of Ships

Their Limit of Size Intelligently Discussed by a British Naval Architect

THE phrase, "The king is dead; long live the king," is familiar to all. If one may be permitted to make use of an analogy, it may be stated, with true Irish wit, "The longest ship in the world is no longer the longest ship in the world; the longest ship in the world has just been launched." This process, whether applied to the longest or the largest ship in the world, has been recurring with persistent regularity for the last seventy years, ever since, in fact, vessels completely built of iron or steel came into being, with the exception of the period during which the famous Great Eastern was in existence. The Aquitania marks the nearest approach to the "thousand-foot ship" that has been so far attained, being within the length of a cricket pitch of that dimension, but it is scarcely probable that she will hold that distinction for any considerable time in view of the rapidity with which new designs and "biggest ships" are nowadays being evolved.

Bewildering Progress

At no time during the above mentioned period has the evolution of these wonderful productions of men's brains proceeded with more rapid strides than during the last few years, when the progress that has been made in the design and construction of the vessels themselves and also in the means of propulsion can only be described as "stupendous." In the short space of a few years we have seen the epoch-making results of the application of steam turbines to marine propulsion, the Atlantic being regularly crossed at a speed equal to that of many express trains, while a daily paper containing the same up-to-date news that is published each morning on shore is actually printed aboard with the aid of that still more wonderful application of modern science, wireless telegraphy.

Such almost bewildering progress gives plenty of scope to the imagination for reflection as to what further improvements are likely to be witnessed in the near future, especially when one considers the clock-like regularity with which these modern liners leave and arrive at their various ports of call, only the very worst of gales being sufficient to make them more than an hour or so late. In particular there is one question of extreme interest to those engaged in the shipping industry or those whose business or pleasure necessitates frequent voyages across the ocean, namely, "Is there any limit to this continued increase of size of vessels, and, if so, what is it?" This question has been frequently discussed by and received close attention of naval architects and others; but it has been more particularly in evidence during the last year or so when we have reached such huge dimensions as those of the Aquitania, with its gross tonnage of nearly 50,000 tons.

It is therefore of great interest to examine the various factors which tend toward further increase and those which tend to retard such increase, bearing in mind the fact that up to the present the tendency appears to be to the former rather than the latter. Before proceeding to the discussion of this question, it will be helpful to quote the actual sizes of some of the largest vessels of recent years, as given in table below:

Ship—	Year of completion.	Length between perpendiculars, ft.	Length over all, ft.	Breadth, ft.
Umbria	1884	501	...	57
Teutonic	1889	565	...	58
Oceanic	1899	685	...	68
Baltic	1904	700	...	75½
Mauretania ..	1907	762	...	88
Olympic	1911	852	...	92½
Imperator ...	1913	879	920	98
Aquitania ...	1914	901	940*	97

*Approximately.

It will be noted that in the short space of the last ten years, gross tonnages have been more than doubled, while the last three years has seen an increase of over 10 per cent in this direction. It will also be noted that, as referred to later, the average annual increase in length, whether taken over the last ten years or over the last 30 years, has been 3 per cent, and is fairly constant over the various periods. A rather striking contrast is revealed if the figures for any of the vessels given in the table are compared with those of a typical wooden vessel of the eighteenth century, of which the Victory, commenced in 1759, may be taken as an example. The dimensions of this vessel were: Length between perpendiculars, 186 feet; breadth 52 feet; and burden, as calculated by the tonnage rules existing in those days, a little over 2,000 tons.

Interesting Comparisons

An especially interesting comparison, however, may be made with three particular vessels:

1. The British Queen, completed in 1839, which was the largest wooden steamship ever built.
2. The Great Britain, completed in 1840, which may be taken as the first representative of the successful iron shipbuilding for long sea voyages; and
3. The Great Eastern, completed about 1858, which was the biggest vessel in existence for 40 years.

The corresponding figures are:

	Length in ft. over all.	Breadth in ft.	Gross tons.
British Queen	275	42	1,860
Great Britain	322	51	3,270
Great Eastern	680	83	19,000

This last-named most extraordinary vessel created such a sensation that, quite apart from the historical side, volumes have been filled with descriptions and criticisms of her design; and, as it has some bearing on the subject under discussion, a brief reference to her will not be out of place here.

She has been justly described as a "leviathan born before her time," which bears high testimony to the genius of her designers, Brunel and Scott Russell. As is only natural, improvement in ship design is a process of evolution, each step forward being a gradual one, enabling the knowledge gained as a result of experience with the preceding step to be embodied in the succeeding stage. This is well illustrated in the first table given, from which it can be seen that the average annual increase in length of the vessels quoted is only about 3 per cent. The Great Eastern, however, which was nearly dou-

ble the length of the longest vessel existing at the time of her design, represented a daring departure from this general principle of evolution; she was, in fact, created almost ab initia by the brain of man without any previous experience of such a huge structure for a guide, and her absolute success from a designer's point of view was a striking tribute to the inestimable value of applied scientific knowledge in the design of ships.

In the nature of things no such jump can ever occur again, but the very fact that British designers realized more than fifty years ago the economy and general advantages to be obtained from the "big ship" is something of which we may well feel proud.

It is interesting to recall that for many years prior to 1899, when the Oceanic was completed, the latest big ships were frequently described as "the largest in the world with the exception of the Great Eastern."

Striking Differences

The most important point to be deduced from the comparison of the two groups of ships refrred to is that during the centuries of evolution of the wooden ship the maximum length attained was 275 ft., whereas the iron or steel ship has evolved from about 320 ft. to nearly 1,000 ft. in less than three-quarters of a century. The reason for this striking difference is not very far to seek. In the first place our knowledge of the stresses and strains experienced by ships has been greatly extended since the introduction of iron and steel for ship building, and, secondly, wood as a material for construction rendered it impossible to obtain sufficient longitudinal strength for the great modern vessels that can be built of steel. In this latter connection, it may be remarked that the bogging and sagging stresses which are the most important to be considered in ship design cause an amount of deformation (in the length of the vessel) which can be measured in inches or fractions of an inch in steel vessels, whereas the corresponding deformation in the old wooden ships was often a matter of feet. The first point to be noticed, therefore, in connection with the question of the size of ships is that of the nature of the materials of construction. Steel is an ideal material for many reasons, among them may be mentioned:

a. Cheapness.

b. Iron ore is widely scattered over the earth's surface.

c. Ease of working.

d. Mechanical properties and durability.

Gross tonnage.	Engines.
8,100	Reciprocating.
10,000	Reciprocating twin-screws.
17,000	Reciprocating twin-screws.
24,000	Reciprocating twin-screws.
32,000	Turbines, four screws.
45,000	Combined turbines and reciprocating
50,000	Turbines, four screws.
47,000	Turbines, four screws.

In b and d are to be found two reasons why it is highly improbable that any other material is ever likely to supersede it—the thickness of the material of the shell required for the proper longitudinal strength of the ship closely approximates to the minimum thickness that is necessary for stiffness to withstand local stresses such as water pressure, docking, etc., without an excessive amount of local stiffening. Should a new material be discovered in the future with a tensile strength, say, ten times that of steel in proportion to its weight, it will not enable the thickness of most portions of a vessel's structure to be reduced in anything like the same ratio, except in the highly improbable event of its stiffness and elasticity also being ten times that of steel. Of course, slight improvements may be made, such as that claimed by the use of vanadium steel, but these would be slight only, and would have little bearing on the question of the limit of size of vessels. It may therefore be safely prophesied that the limit of size will not be greatly affected, if at all, by the materials used in construction.

Personal

J. W. Isherwood, of London, inventor of the Isherwood system of ship construction, and James French, of New York, Lloyds chief surveyor for the United States, visited Cleveland during the early part of June.

Capt. John D. Patterson, of Atlanta, Ga., has been appointed general superintendent of the Panama railroad, vice J. A. Smith, resigned. A farewell banquet was given to Mr. Smith at Hotel Washington, Colon, on May 17.

E. F. DeYoung, of the Johnson Lighterage Co., New York, has been elected a member of the Maritime Association of the Port of New York.

Benjamin F. Cresson, Jr., recently deputy commissioner of docks and ferries of the city of New York has been appointed engineer of the New Jersey harbor commission.

F. J. Fenner and Capt. M. M. Giannomi, of the Morse Dry Dock & Repair Co., New York, have been elected members of the Maritime Association of the Port of New York.

R. B. Wallace, general manager of the American Ship Building Co., sailed for Europe last month, accompanied by Mrs. Wallace.

M. W. Williams, representing the Tomlinson interests and the Berwind Fuel Co., has removed to 1504-6 Rockefeller building, Cleveland.

John A. McGregor, president of the Union Iron Works, San Francisco, visited New York recently.

The Mallory Line is inviting tenders for three passenger steamers, 405 ft. in length.

Charles W. Morse has been elected president of the Hudson Navigation Co., New York.

Items of Interest

The Vesta Coal Co., a subsidiary of the Jones & Laughlin Steel Co., Pittsburgh, launched its fifteenth 200-ft. steel barge, May 27. The Jones & Laughlin Co. is building two barges a month, approximately 10 months of the year, for the Vesta company and will continue to do so until the fleet consists of about 100 barges. Although twice as long as typical coal barges used on the rivers in the Pittsburgh district, the Vesta company has found the larger type just as practical and much more satisfactory during the winter months. Each barge contains about 200 tons of steel.

The new Pennsylvania ore dock in the outer harbor at Cleveland is now making fast time. The steamer E. Y. Townsend with 11,209 gross tons of ore was unloaded in 5 hours and 10 minutes, and the steamer W. P. Snyder Jr., with 11,900 tons of ore, was unloaded in 5 hours 25 minutes on May 19.

The Hamburg-American Line is making inquiry into the cost of constructing six steamers in American yards evidently to engage in coastwise traffic and to take advantage of the remission of Panama canal tolls to ships of American register.

The Lake Carriers' Association and the Great Lakes Protective Association have moved into the offices formerly occupied by the Gilchrist Transportation Co. in the Rockefeller building, Cleveland, O.

The steamers Socapa and Sahara, of the Tomlinson fleet, have been named G. G. Barnum and Cuyler Adams, respectively, after men well known at the head of the lakes.

The Great Lakes Dredge & Dock Co. were the lowest bidders for dredging at Superior Entry and at Portage harbor, Lake Superior.